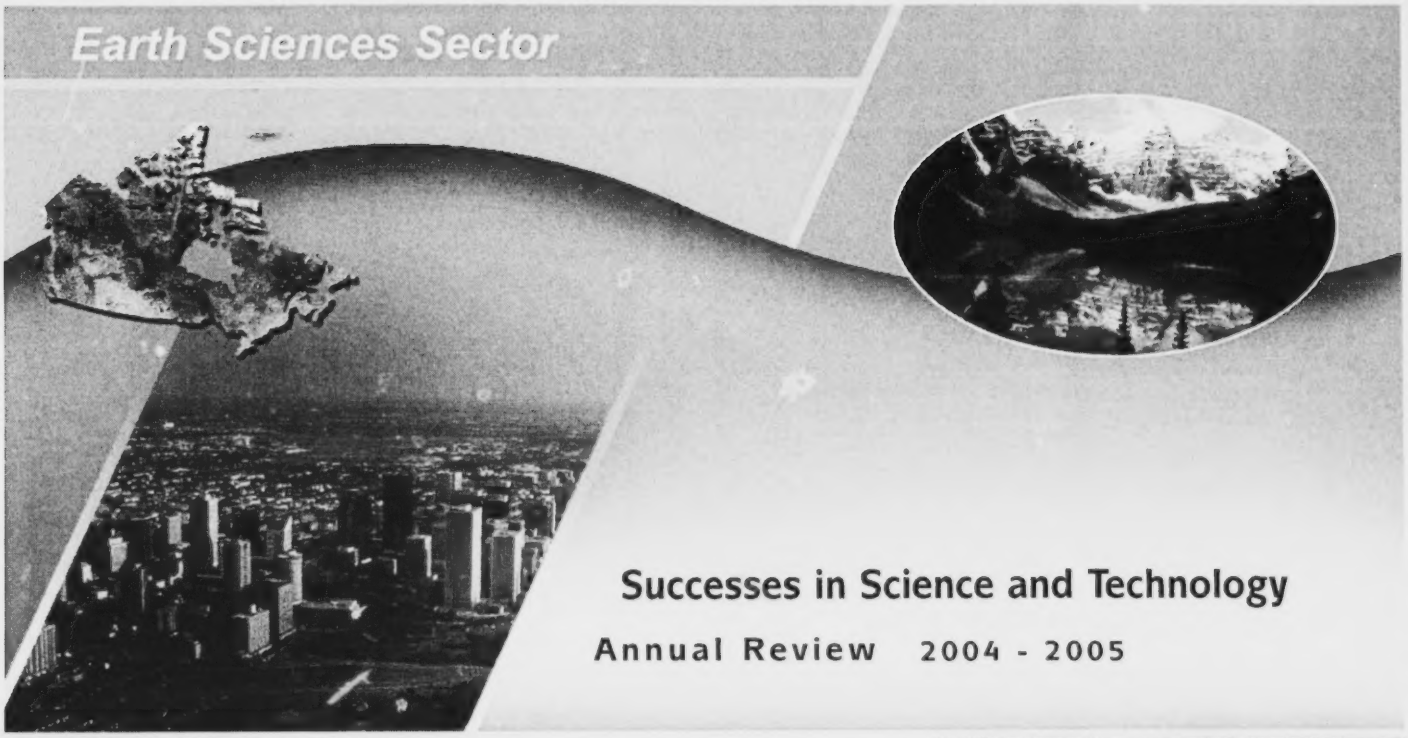
Earth Sciences Sector



Successes in Science and Technology

Annual Review 2004 - 2005

Natural Resources Canada
Ressources naturelles Canada

Canada

Table of Contents

A Message from the Assistant Deputy Minister....3

Earth Sciences Sector....5

A Clean Environment....7

Strong and Safe Communities....11

Sustainable Development of Natural Resources....16

Development of the North....22

Connecting Canadians....26

Aboriginal Peoples....27

ESS International Activities....29

Services....32

National Initiatives and Partnerships....35

Outreach....40

Awards and Honours....43

Information on the Earth Sciences....45

Key Earth Sciences Sector Contacts....46

Earth Sciences Sector Regional Contacts....47

Earth Sciences Sector Across Canada....48

A Message from the Assistant Deputy Minister

It is a pleasure to introduce the *2004-05 Earth Sciences Sector (ESS) Annual Review: Successes in S&T*. Our vision is that "ESS will be, and be recognized to be, a leader in the development, deployment and integration of science and technology into policy and decision-making by Natural Resources Canada, the federal and provincial governments, industry and other stakeholders." That vision is reflected in all that we have accomplished over the past year.

ESS is an issues- and outcomes-driven organization that is governed by its Science and Technology (S&T) Strategy, which is aligned to the economic, social and environmental priorities of the Government of Canada. That has enabled us to ensure that our programs and projects are relevant to and valued by our stakeholders. This Annual Review documents a record of impressive accomplishments in that regard. In addition, we have continued to make advances within our organization to ensure that we deliver results in the most efficient and effective manner possible.

The results are evident throughout the ESS mandate of addressing the priorities of a clean environment, strong and safe communities, sustainable development of natural resources, development of the North, connecting Canadians, Aboriginal peoples, and global trade and investment. As I look back on the outputs and outcomes of the past year, I see we have had great success in addressing all of these priorities.

The accomplishments by ESS have required an outstanding workforce. Throughout the past year, the initiative, intelligence and professionalism of our entire workforce have been in evidence in all we have done. I am proud to lead an organization that comprises so many fine individuals working together for a common cause.

These advances have also been achieved through a vast network of partnerships that extends throughout government, industry and academia. Key principles of the ESS S&T Strategy are to "own only what is necessary; influence all you can" and to "use the best resources wherever they exist through the use of internal and external networks, partnerships and alliances." Our partnerships have been an indispensable ingredient in our successes over the past year.

The past year has been a highly productive period for ESS. I look forward to a similar year in 2005-06.

Irwin Itzkovitch, Ph.D.
Assistant Deputy Minister
Earth Sciences Sector

Additional copies of this report can be obtained from:

Earth Sciences Sector
Communications Group
588 Booth Street, room 309
Ottawa ON
K1A 0Y7

E-mail: dboyd@nrcan.gc.ca

© Her Majesty the Queen in Right of Canada, 2004
ISBN 0-662-41616-3
Catalogue Number: MI-13/2005E

Aussi disponible en français

Earth Sciences Sector

The Earth Sciences Sector (ESS) is one of five sectors within Natural Resources Canada. It is the Government of Canada's principal Earth sciences agency, providing Canadians with timely and reliable geomatics and geoscience knowledge. ESS supports the environmental, social, and economic priorities of the federal government by focusing its science and technology programs on innovative projects that improve the quality of life of Canadians. The Sector also shares its knowledge and expertise in partnerships and cost-recovery projects with clients around the world. The generation and dissemination of information that contributes to the well-being of Canadian citizens is at the forefront of all ESS activities. For more information, please see http://ess.nrcan.gc.ca.

The Sector primarily consists of the Geological Survey of Canada and Geomatics Canada. In addition, three national initiatives, the Polar Continental Shelf Project, GeoConnections, and the Climate Change Impacts and Adaptation Directorate are housed in the Sector on behalf of the Canadian Government.

The Geological Survey of Canada (GSC) is Canada's premier agency for geoscientific information and research. Its world-class experts focus on geoscience surveys, sustainable development of Canada's resources, environmental protection, natural hazards research and technology innovation.

Geomatics Canada (GC) is responsible for gathering, analyzing, interpreting, distributing, and using geographic information. It is recognized internationally as an organization that provides geospatial information using sophisticated technologies. GC consists of the Mapping Services Branch; the Canada Centre for Remote Sensing, which includes the Geodetic Survey Division; and the Legal Surveys Division, which includes the International Boundary Commission.

As mentioned above, ESS operates three national initiatives. GeoConnections is a major national partnership initiative created to build the Canadian Geospatial Data Infrastructure and make Canada's location-based data, applications, and services readily accessible on-line to support a wide range of key public priorities. The Climate Change Impacts and Adaptation Directorate supports research to fill critical knowledge gaps, undertakes and supports assessment of impacts and adaptations, enhances collaboration between stakeholders and researchers, and facilitates policy development. The Polar Continental Shelf Project coordinates logistics support for, and offers expert advice to, Canadian government and university scientists and independent, private-sector and non- Canadian researchers working in isolated areas throughout the Canadian Arctic.

The Sector's Policy Coordination Branch, provides leadership and a central focus for the ESS policy, planning and coordination, and communication functions. Through the International Division, strategic direction is provided for the Sector's international activities, and, in doing so, opportunities are created to promote Canadian Earth science industrial products and services globally.

The ESS Office is charged with a key role in guiding the Sector as it transforms into a more integrated, issues-driven, high-performance organization that produces value for Canadians. The Office promotes this integration and synergy through the project selection and review processes.

ESS Support Services provides leadership and a central focus for ESS financial, administrative, and human resource functions; publishes the scientific output of the GSC; provides information dissemination services, and leads the development and management of the Sector's information technology infrastructure.

The ESS Chief Scientist provides scientific leadership to the Sector and is its principal interface with external scientific organizations.

Clean Environment

A clean and healthy environment is essential to a good quality of life. The Earth Sciences Sector (ESS) is working to ensure that Canadians can enjoy the sustainable and beneficial use of our country's land and resources, now and in the future. ESS is undertaking ambitious projects that involve studying and mapping major Canadian groundwater aquifers, providing information to better assess climate change and its effects, and examining how metals are distributed in the ecosystem with a view to risk assessment. The Sector also contributes geoscience expertise to the federal environmental assessment review process and for resource assessments when new land-use designations are being considered.

Groundwater Program

The ESS Groundwater program is researching the quantity and natural quality of groundwater for the more than 10 million Canadians who rely on it for human, agricultural, and industrial use. Water-management agencies and well owners need accurate hydrogeological information, maps, publications, and models to help in their decision making. Currently under development, a partial national inventory will provide the information needed to ensure a reliable groundwater supply for Canadian communities. For more information, please see: http://gwp.nrcan.gc.ca.

Groundwater Expertise Used in National Water-Information Project

Environment Canada (EC) invited the Groundwater program of ESS to provide input for RésEau, a national web-based portal for the sharing, discovery, access and use of water-based information held by various governments and partners. In recognition of their work on regional aquifers and the national groundwater database, the program is providing science content expertise, advice and partnership support for existing and future RésEau groundwater-related deliverables. In addition, ESS will establish and maintain an ongoing dialogue with the Canadian groundwater community related to demonstration projects to increase awareness of, and foster interest in, RésEau.

Groundwater Program Contributes to Ontario Water Policy

At the request of the Ontario Minister of the Environment's Technical Experts Committee, the Groundwater program of ESS helped prepare a report on source water protection that was released December 6, 2004. This post-Walkerton initiative was undertaken to ensure that Ontario has a comprehensive, science-based program to safeguard its water resources, including the Great Lakes. Another goal of ESS is to create interest in source water policy in provincial and state governments across Canada and the US and in the Canadian Council of Ministers of the Environment. This emphasis underscores the program's role in providing provincial partners and agencies with information related to water and waste management issues. Although source protection today focuses on "protecting the wellhead," future demands to better identify, map, and characterize groundwater recharge areas and watershed-scale flow systems will be an enormous challenge.

Reducing Canada's Vulnerability to Climate Change

The goal of the research conducted by the Reducing Canada's Vulnerability to Climate Change (RCVCC) program of ESS is to assess how future climate conditions will affect the landscape in order to lessen the vulnerability of Canadians, their communities and the country's infrastructure to climate change. This work includes examining the capture and storage of carbon dioxide in geological and biological reservoirs and studying paleo-environmental records to determine the impact of past climates. RCVCC is also providing remote sensing and other geoscience information for impact assessment and is supporting the development of adaptation strategies to reduce climate change impact at the national, regional and local scales. Results are published in scientific and plain-language reports, and new information is used for hazard reduction and sustainable management planning. For more information, please see http://rcvcc.nrcan.gc.ca.

ESS Contributes to International Climate Change Research

RCVCC scientists contributed to and reviewed the International Arctic Climate Impacts Assessment (ACIA) released in Reykjavik, Iceland in November 2004. This Assessment is a joint international project of the Arctic Council and the International Arctic Science Committee to evaluate and synthesize knowledge on climate variability, climate change, and increased ultraviolet radiation and their consequences. The ACIA is the first comprehensive, integrated assessment of climate change and ultraviolet (UV) radiation across the entire Arctic region. Its results are expected to serve as an important element of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) due in 2007. The IPCC was established by the World Meteorological Organization and the United Nations Environment Programme to assess scientific, technical and socio-economic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation.

Provinces and Municipalities Use ESS Results in Climate Change Planning

Several RCVCC initiatives have involved assisting provinces and municipalities to deal prudently with Canada's changing climate. For example, in collaboration with the Canadian Institute of Planners (CIP), RCVCC scientists have published information on-line to help planners assess the vulnerability of Canadian municipalities to climate change. Located on the CIP website, http://www.cip-icu.ca, "Planning for Climate Change" also equips municipalities to design adaptation strategies. In addition, an RCVCC presentation during the 2004 InfraGuide National Forum encouraged municipalities to include ESS climate change impact results in their planning. A presentation on municipal case studies and the impacts of climate change on infrastructure was also given at the 2004 Transportation Association of Canada (TAC) annual conference and exhibition.

Remote Sensing Systems Monitor Atmospheric Carbon Dioxide

RCVCC has successfully promoted the use of remote sensing technology to monitor carbon dioxide in the Earth's atmosphere and better equip Canada to meet its reporting obligations under the United Nations Framework Convention on Climate Change. For example, ESS scientists are coordinating an international research team to develop advanced techniques for monitoring atmospheric carbon dioxide using data from Earth observation satellites. These techniques will help scientists understand atmospheric carbon and carbon cycles over forests in Canada, Europe, and Russia. ESS also helped develop a joint statement of cooperation between Canadian and American carbon-cycle research

communities. In addition, ESS scientists and specialists from Canada's remote sensing industry documented, measured, and sampled vegetation along the Dempster Highway in the Yukon and the Northwest Territories. The resulting extensive database will be used to develop methods for monitoring and assessing terrestrial carbon fluxes in Canada's North.

Assessing Climate Change Impacts on Northern Community Structures

ESS scientists are leading a number of climate change impact studies in the North. These studies include work on: degrading permafrost and road foundations with the Government of the Northwest Territories, sea ice in the Northwest Passage, and rising sea level and related coastal flooding and erosion hazards in Arctic communities. The RCVCC program is also working with the Canada Mortgage and Housing Corporation, Indian and Northern Affairs Canada, and Inuit Tapiriit Kanatami to develop assessment tools for decision-making on adaptation to northern climate changes.

Metals in the Environment

Metals exist in the environment because of both natural geochemical processes and human activities. Under the Metals in the Environment (MITE) program, ESS is investigating how specific metals enter the ecosystem to help regulating bodies better assess risks associated with metals and reduce their impact. MITE is conducting research in three areas: comparing natural vs. anthropogenic metal sources, describing metal concentrations across Canada, and helping identify locations where natural variations may pose a risk by defining background levels. ESS delivers the MITE program in partnership with other federal government departments that have specific responsibilities regarding toxic substances, as well as with provincial and territorial agencies and academia. For more information, please see http://mite.nrcan.gc.ca.

Collaboration with Health Canada Reduces Metal-exposure Risks

The MITE program of ESS is working with Health Canada to ensure that Canadians avoid unsafe levels of certain metals such as mercury, arsenic, lead and nickel. By establishing baseline levels of these metals against which sites may be assessed, researchers can flag areas where geochemical levels exceed acceptable standards. The responsible agencies can then take steps to reduce the risks associated with these metals. The program has compiled more than 300 geochemical surveys, mainly from federal and provincial publications. These surveys are available as GSC Open File Reports both on CD and on line, and include guidelines for readers on interpreting the data.

Multidisciplinary Project Uncovers Health Risks Associated with Abandoned Mines

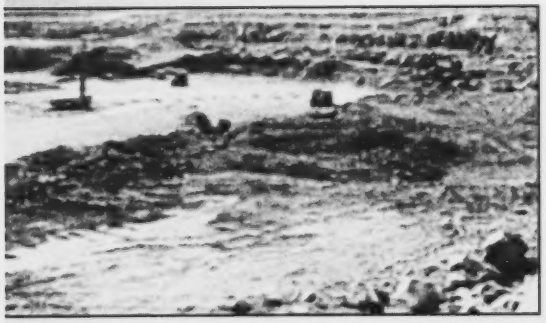
Working with researchers from three other federal departments, MITE is identifying and characterizing the geochemical environment around abandoned mines. Specifically, an inter-disciplinary project team studied the levels of mercury and arsenic dispersed from abandoned gold mines in Nova Scotia. The researchers collected samples of rocks, water, and soil and then analyzed these samples for concentrations of metals as well as other geochemical properties. With this data, regulating bodies can then assess the potential health risks and develop risk management strategies, if necessary.

Legislated Environmental and Resource Assessments

Under the Legislated Environmental and Resource Assessment (LERA) program, ESS provides expertise in federal environmental assessment reviews under the Canadian Environmental Assessment Act (CEAA). This expertise is vital to the full evaluation, mitigation and decisions related to potential environmental impacts of development projects. Through LERA, mineral and energy resource assessments are provided to ensure that the economic and strategic significance of non-renewable resources are considered in federal decisions to establish protected areas, such as national parks and national marine conservation areas, on lands under federal jurisdiction.

Supporting Environmentally Sound and Sustainable Development Decision-making

As part of the environmental assessment process, ESS scientists contributed their expertise to more than 50 development project reviews in 2004-2005. These reviews involved mines, hydro, wind and nuclear energy developments, liquefied natural gas facilities, recreational facilities, linear infrastructure and urban and industrial waste disposal plants. For example, LERA led the review of the hydrogeology aspects of the Victor Diamond Project — the first proposed diamond mine in the James Bay Lowlands of northern Ontario. Groundwater quality and quantity were important considerations in the assessment of the impacts of the dewatering of this proposed open pit mine on the surrounding wetlands.



Making Informed Decisions about Establishing Protected Areas

Working collaboratively through interdepartmental and inter-agency committees, the LERA program of ESS helps ensure that mineral and energy resource assessments are conducted and considered in the decision-making processes related to protected areas under federal jurisdiction. In 2004, ESS scientists completed the hydrocarbon resource assessments for the proposed Beaufort Sea Marine Protected Area and the proposed Scott Island Marine Wildlife Area off the west coast. In addition, an agreement was signed between Parks Canada and ESS to initiate a mineral resources assessment for the proposed expansion of the Nahanni National Park Reserve. This assessment is part of the park expansion feasibility study as agreed to by the Deh Cho First Nations and Parks Canada.

Strong and Safe Communities

Canadians experience an enviable level of safety and security in their homes and communities and while travelling across the country. The Earth Sciences Sector (ESS) plays an important role in keeping our communities strong and safe. Experts in a wide range of natural hazards enhance our preparedness for potential emergencies by contributing to improving our infrastructure's resilience and testing our response systems. In addition, ESS helps provide critical aeronautical charts and publications to military and civil authorities and topographical information and maps in case of national emergencies. ESS is also responsible for maintaining the border demarcation between Canada and the United States.

ESS Responds to Major Earthquake and Tsunami Disaster

Scientists and experts from ESS responded immediately in the aftermath of the 9.0 magnitude earthquake and resulting tsunami that struck Southeast Asia on December 26, 2004. As part of the international response to the event and as Canada's premier earthquake research organization, ESS is sharing its scientific and technological expertise to help in the knowledge of, response to and reduction of impacts from these events at home and around the world.

Immediately following the disaster, ESS participated in international post-tsunami disaster meetings in Japan, India, and Thailand. A team of experts was sent to the Seychelles Islands in the western Indian Ocean at the request of the International Tsunami Society as part of an international scientific effort to document the tsunami and its effects. Canadian geoscience expertise is being provided for the design of global multi-hazard warning systems, better use of seismic, remote sensing, and other natural hazard monitoring networks, the improvement of building code standards and for training and development of expertise in earthquake and related hazards.

At the invitation of the Royal Thai Government, a team of Canadian specialists, including a scientist from the Canada Centre for Remote Sensing, spent two weeks assessing the environmental impact in three of the six affected provinces in Southern Thailand. The purpose of this mission was to assist the Chulabhorn Research Institute to determine the rehabilitation needs of tsunami affected coastal areas and to help match the identified needs with Canadian Government capabilities. The team's final report recommends ways that Canada can offer tsunami-related technical assistance, including Earth Observation data, for Thailand's post-tsunami sustainable development strategy. The Royal Thai Government will use this information to better prepare their country for the future.

Natural Hazards and Emergency Response

The Natural Hazards and Emergency Response (NHER) program of ESS focuses on avoiding disasters by reducing the risks from the five hazards assigned to Natural Resources Canada under the Emergency Preparedness Act (earthquakes, volcanoes, tsunamis, landslides, and magnetic storms). The program also contributes to the Federal Nuclear Emergency Plan, Comprehensive Nuclear Test Ban Treaty and emergency geospatial information requirements of the Emergency Preparedness Act. Emphasizing population centres and critical infrastructure at risk, NHER produces national hazard assessments and improves access to digital ESS hazard information. National monitoring and observatory networks underpin NRCan's response to earthquakes and geomagnetic hazards. For more information, please see http://nher.nrcan.gc.ca.

Post-Tsunami Response for Canadians

After the events of December 26, 2004, Canadians needed to know what had happened and if it could happen here. Since education is the key to informed decisions and risk reduction during natural disasters, ESS experts supplied extensive, round-the-clock information to the media and to the public via interviews and the ESS web site following the tsunami. The Geological Survey of Canada continues to operate a national earthquake-monitoring network and provides 24/7 earthquake and volcanic information. Canada also participates in the sharing of real-time information from seismometers and tidal gauges among Pacific Rim countries to provide a warning network for tsunamis generated by large earthquakes in the Pacific. For more information, please see http://seismo.nrcan.gc.ca.

Canadian Discovery May Shake up Earthquake Hazard Preparedness

Two ESS researchers have discovered an entirely new tectonic plate boundary phenomenon called episodic tremor and slip (ETS) that may help scientists better understand large earthquakes and their potential timing more accurately. By analyzing surface ground motions and deep seismic tremors, ESS researchers discovered that every 13 to 16 months, the lower reaches of the subducted Juan de Fuca Plate slip a few centimetres under southern Vancouver Island over a period of two weeks. Farther west and closer to the surface on the same inclined fault interface, the North American plate and the Juan de Fuca plate remain locked. The deep episodic slip puts extra pressure on the locked zone, increasing the likelihood that an ETS event could spark a damaging 9.0 magnitude earthquake. Mapping, monitoring, and modelling ETS will better prepare southwest British Columbia and northwest U.S. for large earthquakes. In fact, international researchers are now focusing on ETS, which is one of the primary scientific targets of the US $319 Million National Science Foundation EarthScope project.

Eastern Canada Storm-surge and Tsunami Warning System in Development

Tsunamis rarely occur in the Atlantic Ocean, but storm surges are a more common cause of coastal flooding. For example, a wind storm and sea surge along the east coast of Newfoundland in March 2005 caused millions of dollars of damage. As a result of the Sector's contributions to international efforts to improve tsunami warning systems after the devastation on December 26, 2004, ESS is partnering with the Department of Fisheries and Oceans and potentially affected countries bordering the Atlantic Ocean to develop a storm surge and tsunami alert system.

Curbing Corrosion in Pipelines—Applied Geomagnetism Research

The Geomagnetic Hazards project of NHERP recently published a study on current flow and premature corrosion within pipelines and this research is already finding practical applications. The company that is designing the corrosion-protection system for the Mackenzie Valley pipeline has asked for an analysis of how telluric currents (natural electrical currents that flow in the ground) will likely affect the proposed pipeline. It wants to use this information to design its pipeline protection systems. In addition, a Canadian corrosion engineering company with projects all around the world included content from the ESS study in courses it gives to the National Association of Corrosion Engineers. A third application, developed in-house, will enable pipeline companies to monitor telluric currents along their pipelines.

Fast Delivery of Radiation Contamination Maps to Emergency Responders

Rapid access to geospatial information better equips emergency response teams to save lives and property when disasters strike. The ESS Nuclear Emergency Response team has developed a portable tool kit to map radiation contamination quickly using aircraft or road vehicles. The team and kit can be mobilized in just four hours to determine the type of contamination, locate and measure it, and relay that information immediately to command and ground crews. In addition, using modern delivery processes such as computer-based task tracking, the Natural Hazards Information System (NHIS) team of ESS can now deliver custom maps and remote sensing information for emergencies within six hours of a request. These systems were successfully demonstrated in a multi-agency emergency simulation in Suffield, Alberta in February 2005.

Monitoring the Impact of Geomagnetic Storms on Power Systems

Geomagnetic disturbances can have a serious effect on power systems as was demonstrated on March 13, 1989, when the province of Quebec was without power for over 9 hours. During these disturbances, geomagnetically induced currents can saturate power-system transformers, which act as electrical conductors. This saturation can damage the transformers, create voltage dips, and in extreme cases, cause power blackouts. ESS scientists have now developed a real-time Geomagnetically Induced Currents (GIC) Simulator that monitors the impact of the Earth's geomagnetic disturbances on power systems. Using real-time magnetic data from the Ottawa Geomagnetic Observatory, the Real-Time GIC Simulator continually updates a model of the GIC flow throughout a power-system network. This model provides engineers and system operators with graphs and tables that offer an up-to-date view of GIC magnitudes that can be used to regulate the network to compensate for the GIC flow.

Reducing the Impact of Landslides and Rock Falls on Infrastructure

ESS experts are addressing ways to reduce the significant damage that occurs to Canadian buildings and infrastructure due to landslides. A simple and practical procedure to predict the depth of rock fall penetration has been developed by ESS experts. The resulting *Rockfall Damage Calculation* gives the pipeline industry an easy-to-use guideline for minimum burial depths of pipes in mountainous terrain in order to mitigate rock fall impacts. In addition, the new *Earthflow Damage Model* gives an innovative interpretation of earth flow impact on bridge foundations. In many cases, this information reveals that conventional oversized foundations are no longer needed for large infrastructure projects, saving money without compromising safety.

Aeronautical Charting

Business, trade, and national defence all rely on aerial navigation. By producing accurate and relevant aeronautical charts and publications with NAV CANADA, the Aeronautical and Charting program of ESS contributes extensively to the safety and security of Canadians. A safe and secure airspace allows business to flow, tourism to flourish, and Canadians to prosper. For more information, please see http://aero.nrcan.gc.ca.

Canada Airport Manoeuvring Surfaces (CAMS) Improves Aviation Safety

The Aeronautical Charting program of ESS focused on the requirements of NAV CANADA and its end users in the development of a new web-based product that improves airport safety by lessening the likelihood of runway incursions. Derived from other aeronautical publications, Canada Airport Manoeuvring Surfaces (CAMS) displays diagrams of Canadian airport manoeuvring areas, and NAV CANADA makes these airport diagrams available to general aviation pilots free through its web site (http://www.navcanada.ca). Since many private pilots are familiar with existing paper versions of airport diagrams, the publication is also available in book format.

Assisting Civil and Military Air Navigation Safety

ESS specialists in the Aeronautical Charting program are working with aviation stakeholders to improve the quality of aeronautical charts and publications and to produce these outputs more efficiently. The program recommended improvements for the visual flight rules chart series and is helping NAV CANADA standardize the chart series for air traffic controllers. Numerous organizations benefit by sharing the information and insight generated by the Aeronautical Charting program. For instance, the RCMP monitors abandoned airfields in the north for emergency landings and for drug smugglers and the Ontario Ministry of Health plans safer flights for its helicopter ambulance fleet around Kenora.

Improved Access to Millions of Aerial Photographs

The National Air Photo Library (NAPL) launched its new web-based search tool http://airphotos.nrcan.gc.ca in 2004. 'NAPL On-Line' makes it easier to search and retrieve information on any of the over three million aerial photographs from across Canada in its collection. Users can view the "footprint" of an aerial photograph, and, in some cases, a "thumbnail" of a scanned image of the footprint area. Over 10,000 footprints are currently accessible, and 1,000 new scans are added weekly. Once a photograph has been located, it can be ordered on-line as a digital file or laser print.

Maintaining the Canada-United States International Boundary

The International Boundary Commission (IBC) maintains the Canada-U.S. boundary under the terms of a 1925 treaty that provides for the enforcement of customs, immigration, national security, and other laws. The boundary's demarcation also allows the federal government to exert Canada's sovereignty. Each year, the IBC program maintains not less than 150 km of boundary and submits a Joint Annual Report to Canada's Minister of Foreign Affairs Canada (FAC) and the United States Secretary of State. For more information, please see http://www.internationalboundarycommission.org.

The International Boundary Commission Receives Significant New Funding

In October 2004, the Canadian Treasury Board approved funding of $1.6 million for each of the next five years, bringing the total budget of IBC to $2.4 million. This new funding will help the IBC's Canadian Section to maintain the Canada-U.S. border and to deal with a backlog of boundary-maintenance projects. After 2010, the budget will drop back to $2 million each year. Treasury Board increased the funding after an independent study concluded that IBC needed more money to deliver this essential service. The boundary between Canada and the U.S. extends 8,891 kilometres across North America's undefended border.

Field Crews Attend to Canada-U.S. Border

Boundary maintenance involves inspecting boundaries, restoring and maintaining monuments, resurveying, and clearing vegetation. In light of increased border-security, Canada concentrates its maintenance and clearing in the most populated areas along the Quebec-New York, Vermont, New Hampshire, and Maine boundaries and along the British Columbia-Washington boundary. The IBC conducted two field projects between May and September 2004. One project involved replacing 15 monuments and repairing 23 along a 75-km stretch of boundary between Quebec and Maine. In the other project, a field crew cleared the vista along a 28-km of boundary also between Quebec and Maine.

Sustainable Development of Natural Resources

Sustainable development of Canada's immense natural resources requires careful decision making to efficiently and responsibly use our natural, human, and economic resources. The Earth Sciences Sector (ESS) is contributing to Canada's progress on sustainable development by collecting, processing, and making accessible its geological and geomatics knowledge.

Consolidating Canada's Geoscience Knowledge

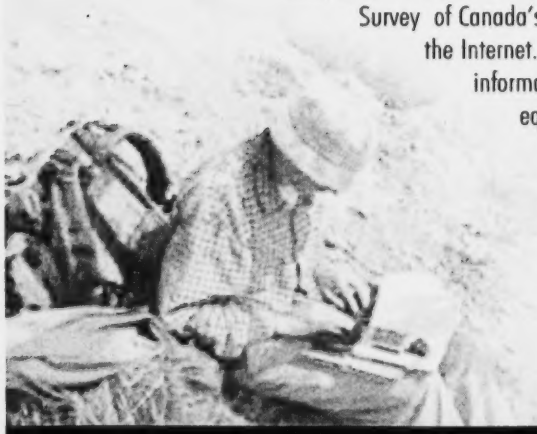
The Consolidating Canada's Geoscience Knowledge (CCGK) program enhances ESS partnerships with provinces, territories, industry, and academia. The program also provides more efficient, effective, and comprehensive access to geoscience information and knowledge. Achieving these goals will enable Canada to compete more effectively for global investment in oil, gas, and mineral exploration and development and better equip the country to make sound sustainable development decisions. For more information, please see http://ccgk.nrcan.gc.ca.

Federal, Provincial and Territorial Governments Endorse Cooperative Geological Mapping Strategies

Members of the Consolidating Canada's Geoscience Knowledge (CCGK) program coordinated numerous regional workshops throughout 2004 to consult with the leaders of provincial and territorial Geological Surveys in order to define the key outcomes for the Cooperative Geological Mapping Strategies initiative. The resulting Implementation Plan was developed by members of the National Geological Surveys Committee and endorsed by Canada's Mines Ministers. This agreement is a new model for federal and provincial-territorial collaboration and focuses public geoscience contributions to secure clean energy supplies for Canada, to help resource-based communities prosper, and to develop resource based economic opportunities. Information on the Cooperative Geological Mapping Strategies is available at http://ccgk.nrcan.gc.ca.

Geoscience Data Repository Simplifies Data Sharing and Integration

In 2004, the CCGK program introduced the Geoscience Data Repository (GDR), a distributed network of databases that makes it easier for users to access and use the extensive holdings of ESS resource geoscience data. On-line, low-cost access to these data is essential for geological mapping and for mineral and hydrocarbon resource exploration. The GDR (http://gdr.nrcan.gc.ca) employs a series of services and applications to more effectively manage geoscience data, information, and its subsequent dissemination. It now distributes a significant portion of the Geological Survey of Canada's extensive mineral and energy geoscience legacy data and information through the Internet. As well as providing this service externally, the GDR will become an important information asset to internal ESS programs and activities. These developments better equip the Canadian Geoscience Knowledge Network to assist Canada's federal, provincial, and territorial geoscience agencies to share and integrate geoscience data and knowledge.



Geoscience for Oceans Management

This program contributes to the geoscience knowledge that is required to enhance decision making in Canada's offshore lands. This knowledge is necessary to balance social, economic, and environmental considerations with land-use decisions, including those affecting offshore structures and resource-development. Underpinning this program is a systematic approach to sea-floor mapping necessary for integrated ocean management. The legislative and strategic framework for this program is found in the Canada Oceans Act and Canada's Oceans Strategy. For more information, please see http://www.gom.nrcan.gc.ca.

Marine Geoscience Information Used to Manage Dredge Spoils in the Strait of Georgia

The Geoscience for Ocean Management (GOM) program of ESS is helping to balance the competing interests of dredge disposal and habitat protection in B.C. The Fraser River, one of Canada's busiest waterways, routinely requires dredging to accommodate ocean-going ships. The dredged material is deposited off Sand Heads, at the mouth of the Fraser River's main channel. ESS scientists studied the suitability of this disposal site by mapping the Georgia Basin with multibeam sonar and measuring sediment transport. The study revealed a potential issue with slope instability, which will be examined further with the University of Victoria's VENUS cabled observatory. ESS scientists also evaluated depositing dredged material at an alternative site on the adjacent tidal flats of Roberts Bank. Deposits here may re-nourish the sediment transport system and preserve critical habitats for migratory birds.

Seabed Maps Help Nova Scotia Scallop Fishery Cut Costs and Improve Catch

Canada is committed to developing high resolution seabed maps of the bathymetry and surficial geology of its continental shelf to help manage and conserve its biological and mineral resources. In partnership with the Department of Fisheries and Oceans and the local scallop fishing industry, the GOM program of ESS recently mapped scallop grounds off southwest Nova Scotia using multibeam sonar technology. Fisheries managers within the government use bottom habitat maps to develop sustainable harvest plans and the valuable commercial scallop industry uses them to cut costs and boost catches by concentrating on areas identified as scallop habitats. As well, these maps allow fishers to avoid rugged terrain ill-suited to towing fishing gear.

Assessing Environmental Impact of Beaufort Sea Oil and Gas Exploration

In late 2005, Canada will drill its first Arctic offshore oil and gas exploration well in 15 years in the Beaufort Sea. This well, the first of four to be drilled by 2009, reflects renewed interest in frontier oil and gas. The GOM program of ESS is using seabed geohazard research to assess how this exploration will affect the environment. Working with the oil industry, the Inuvialuit, and Fisheries and Oceans Canada, ESS is mapping active shallow gas vents, mud volcanoes, abandoned artificial islands, subsea permafrost, seabed scouring from ice keels, and underwater ecosystems. This work relies on multibeam technology to generate 3D images that will ultimately assist policy makers, regulators, and other decision makers to meet public health and safety objectives and protect the environment.

Habitat Mapping on the Scotian Shelf

Which areas of the Eastern Scotian seafloor are the most sensitive to resource exploration and commercial fishing, and how should Canada balance these endeavours with the health of the seafloor ecology? These are the questions that the GOM program of ESS and the Department of Fisheries and Oceans are answering by mapping the seafloor habitat of the Scotian Shelf. GOM's Eastern Scotian Shelf Integrated Management project will generate insight that can be used to plan the installation of structures on the sea floor and resolve conflicts regarding sea-floor use. The mapping solutions and data that this project produces will meet the needs of government, First Nations, ocean industries, resource users, environmental interest groups, coastal communities, and university researchers.

Sustainable Development Through Knowledge Integration

Effective implementation of natural resource policies requires access to reliable and up-to-date information about our resources. Each project in the Sustainable Development Through Knowledge Integration (SDKI) program of ESS addresses specific technological barriers that need to be overcome in order to provide consistent and current data about Canada's natural resources. SDKI contributes new technology to facilitate the integration of Earth Science information and expert knowledge into policy making. ESS scientists are using their expertise to develop data models, data integration methods and visualization techniques that help monitor environmental change resulting from human or natural causes. These activities use ESS data based on the Canadian Geospatial Data Infrastructure as well as information resources from a broad range of other organizations. For more information, visit http://sdki.nrcan.gc.ca.

Wildland Fire Reporting System Leading the Global Fire Community

On average, 2.5 million hectares of Canadian forests burn annually. ESS scientists are leading the world in using Earth observation imagery and innovative web-based tools to help monitor and map forest fires. A team from the SDKI program of ESS and the Canadian Forest Service (CFS) is developing the Canadian Wildland Fire Information System (CWFIS) to monitor and report annually on the impacts of forest fires. This comprehensive system combines satellite data products and ground-based fire and weather data with fuel consumption and carbon budget models. In conjunction with CFS's National Forest Carbon Monitoring, Accounting and Reporting System, it provides a mechanism for estimating carbon emissions from wildland fires. These estimates will be included in NRCan's report against our Kyoto commitments and the United Nations Framework Convention on Climate Change. CWFIS data can also be used for issues related to climate change, forest management, and biodiversity and habitat fragmentation.

Restoring Ecologies Around Abandoned Mine Sites

SDKI has collaborated with the City of Greater Sudbury to track changes in plant species and vegetation near abandoned mine sites in the Sudbury region. Imagery from satellite remote sensing systems and ground observations are being used to help track a land rehabilitation project begun by the city in 1978. Although much progress has been made in restoring biologically diverse and productive forests, new information indicates that trees grown naturally in the affected areas are less healthy and more susceptible to insect infestation and diseases than those outside these areas. SDKI's data and expertise will help Sudbury and others involved in the reclamation of the estimated 27,000 remaining abandoned mines in Canada.

Assessing the Impact of Urban Growth and Land Use on Energy Consumption

According to 2001 census data, 64% of Canada's population lives in twenty-seven cities with populations greater than 100,000. SDKI is addressing the recommendations of the 2002 *Prime Minister's Caucus Task Force on Urban Issues* to develop indicators of how urban growth and land use affects transportation-related energy consumption. In response, SDKI project scientists are assembling information from the 30-year record of Landsat acquisitions and other historic federal land-use databases. Land-cover, land-use, and census information for each city are being integrated to produce four quantifiable, energy-related sustainability indicators: urban land use per capita, land-use mix, urban compactness, and road network connectivity. In 2004, an analysis of these four indicators for twenty-eight cities was prepared for the policy makers in NRCan's Energy Sector. Phase II of this project will apply historical land use information to generate a time series of urban sustainability trends, information that can guide policies about transportation, energy, and development in urban areas.

Groundwater and Geohazard Vulnerability Assessments Assist Community Planning

Municipal planners in Pender Island, British Columbia, are using ESS groundwater vulnerability maps and SDKI human settlement scenarios in the development of their official community plan. The web-based decision support tools integrate socio-economic and geoscience information, enabling municipal planners to examine different development scenarios and assess the potential impacts of groundwater and geohazard risks in different areas. These new tools offer planners three important advantages: the capability to develop alternative human settlement scenarios and present them visually, web access to the data and scenario-modelling tools, and the information and support that ESS geoscientists can provide.

Interactive Web-based Tools Reveal Land-Use Trends in Ottawa

SDKI is developing web-based visualization tools to allow users to explore and interact with a wide range of visual geospatial data from different periods. For instance, by incorporating topographic maps, imagery, virtual reality models, and aerial photographs, SDKI developed an animated time series for Ottawa that spans 82 years. An even more detailed animation of a small area in the city centre was also created to highlight the evolution of Ottawa's transportation and urban development. ESS contributed this product to help Ottawa celebrate its 150th anniversary in 2005.

Geomatics for Sustainable Development of Natural Resources

The Geomatics for the Sustainable Development of Natural Resources (GSDNR) program promotes awareness of and access to the high-quality geospatial information and products of ESS. Helping Canada make responsible decisions about the sustainable development of its natural resources, GSDNR projects provide basic geospatial information layers such as geographic names, national thematic frameworks, elevation data, hydrography, transportation networks, and satellite ortho-rectified imagery. These layers are generated according to national data standards developed through partnerships and a common technological environment with various data producers. For more information, please see http://gsdnr.nrcan.gc.ca.

National Road Network Updates

The recently completed National Road Network (NRN), Level 1, contains accurate, consistent, and up-to-date information about every highway, thoroughfare, street, boulevard, crescent, avenue, and cul-de-sac in the country. This information is valuable for geographic information systems developers who want to build global positioning systems or web-based applications that rely on roadway data. For example, a rural fire department could use this resource to respond faster to fires and also to save on gas and vehicle wear and tear.

National Hydro Network Gains an Important Standard

In August 2004, the Canadian Council on Geomatics (CCOG) approved a National Hydro Network (NHN), Level 1, Edition1, standard for describing and modelling features of the Canadian surface-water system (inland waters and coastline). CCOG commissioned experts from the Centre for Topographic Information of ESS, Nova Scotia's Geomatics Centre, and British Columbia's Base Mapping and Geomatics Services to develop the standard using the same approach that guided the development of the standard for the National Road Network. It is anticipated that the NHN model will be completed by 2009 and could be used for water flow analysis, watershed monitoring and management, as well as data querying and manipulation. For example, the NHN could be used to monitor water levels in the case of drought or flood to help decision-makers evaluate the need for relief measures or evacuation.

New National Landsat 7 Orthographic Images Offer Resource Management Benefits

Led by the Centre for Topographic Information of ESS, various federal, provincial, and territorial agencies have established the GeoBase Data Alignment Layer, which comprises Landsat 7 satellite orthographic images of Canada. Having a unique, shared geometry for topographic spatial reference makes it easier to integrate data from the many federal, provincial, and territorial databases in use across Canada. Orthorectified images remove perspective distortion by compensating for the Earth's curvature and can be applied in many resource management situations. For example, the Canadian Forestry Service uses them as part of their National Forest Carbon Accounting program. Information derived from the images is also used by Parks Canada to better manage Canada's national parks. The downloading of over 135,000 images from the GeoBase portal during the month of February 2005 shows the value and usefulness of this data.

Hyperspectral Technology May Change the Mapping of Northern Canada

Hyperspectral remote sensing can identify potential mineral exploration targets more quickly and economically than traditional methods and this could potentially revolutionize the mapping process in northern Canada. In the Earth Observation Data Standards Project of GSDNR, ESS scientists are working to improve the accuracy of airborne hyperspectral data. While the need for on-site validation will still be essential, hyperspectral technology will provide valuable information enabling programs to more effectively allocate and schedule resources. These developments will have a direct impact on ESS projects such as those in the Northern Resources Development program.

New Instrument May Lead to New Energy Resources

The Paleomagnetism Laboratory of ESS in Sidney, B.C., recently installed a new instrument known as a *coercivity spectrometer*. This instrument rapidly identifies and measures the concentration of iron minerals in samples. In one of the first studies using the instrument, the lab will determine what chemical reactions occur when natural gas hydrates form in the Canadian Arctic. If a unique magnetic signature is found in sediments that contain gas hydrates this information could be used by exploration companies to find new deposits of this potential new energy resource.

GeoNames for 'Next Generation' Paper and Digital Maps

There is growing interest in linking the names of places and physical features on maps directly to powerful database searches in the digital map world. In partnership with the provinces, GSDNR's GeoNames Application project is providing geographical names linkages at both the National Atlas (1:1M) and GeoBase (1:50K) scales. Recently, the Newfoundland and Labrador Names Board has agreed to co-operate with ESS on the delineation and quality control of geographical names and distribution of paper maps during 2006. Through the Concise Gazetteer Atlas project, additional innovations for Canada's many northern aboriginal place names include the incorporation of pronunciations and special syllabic characters.

Gas Hydrates – Fuel of the Future?

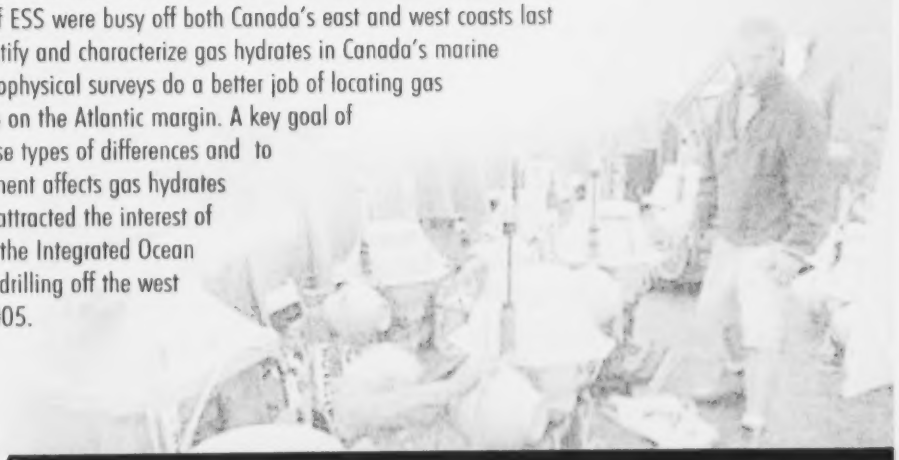
The Gas Hydrates—Fuel of the Future? program contributes to the development of this unconventional energy source. Gas hydrates could hold 1,000 years of an environmentally friendly fuel supply, compared to about 10 years of natural gas reserves and 100 years of conventional gas resources. ESS coordinates the science activities of the program, which identifies the gaps in scientific and technological knowledge required for the sustainable development of this resource. Large gas hydrate deposits are located mainly in the high Arctic and in offshore areas at water depths greater than 800 metres.

Mallik Gas Hydrate Study Results to Be Published in 2005

During 2004-2005, the Gas Hydrates program continued its studies of gas hydrate properties and reservoir behaviour as well as characterized terrestrial and marine gas hydrate occurrences. In particular, ESS scientists worked with the Mallik gas hydrate research well consortium, the world's leading gas hydrate production and characterization study group, to analyze and create a report on the results of the previous year's activities in the high arctic MacKenzie Delta. The preliminary results of this benchmark experiment were presented at scientific and technical meetings. They indicate that under specific circumstances, gas hydrates could be a potentially economically viable source of methane. Additional work needs to be done to provide the necessary engineering and economic parameters for investment evaluation by Canadian resource industries. The final scientific report will be published in summer 2005.

Gas Hydrates Marine Research Captures Interest of International Scientific Community

Scientists from the Gas Hydrates program of ESS were busy off both Canada's east and west coasts last year conducting geophysical surveys to identify and characterize gas hydrates in Canada's marine environment. The research revealed that geophysical surveys do a better job of locating gas hydrates on the Pacific margin than they do on the Atlantic margin. A key goal of these marine activities is to understand these types of differences and to learn more about how the tectonic environment affects gas hydrates under the sea. The Pacific margin research attracted the interest of the international scientific community, and the Integrated Ocean Drilling Program plans to conduct scientific drilling off the west coast of Vancouver Island during August 2005.



Development of the North

Canada's North is a vast and challenging region, home to many of Canada's Aboriginal people and endowed with a wealth of natural resources. Its extreme climate, widely dispersed population, and limited infrastructure present challenges to improving the quality of life of northern Canadians. The Earth Sciences Sector (ESS) is working to ensure that northern governments and communities have access to up-to-date information about the land, along with the modern technology and training they need to effectively manage their lands and improve their economic self-sufficiency.

Northern Resources Development

The Northern Resources Development (NRD) program of ESS creates and makes accessible new, comprehensive mineral and energy geoscience products, such as regional databases, maps, and reports. These products encourage development by raising private sector awareness of investment opportunities in the North and reducing exploration risks. Specific projects help northerners build the knowledge and skills they need to help guide and participate in this development and better prepare them for employment in the exploration and development sector.
For more information, please see http://nrd.nrcan.gc.ca.

Increasing Oil and Gas Prices Boost Demand for ESS Expertise

In June 2004, the Inuvik Petroleum Show, the largest meeting in Canada to focus on northern energy, invited ESS to give several presentations and workshops relating to northern oil and gas resources in the Mackenzie Delta region. Industry expressed strong interest in new resource-exploration concepts discussed at meetings with GSC scientists who work on the Mackenzie Corridor Project. These concepts could lead to reducing the risk and expense of energy exploration. As well, ESS expertise and published maps led one of the largest integrated petroleum companies in Canada to acquire a 412,000 hectare tenure in the coal-methane beds of the northern Bowser Basin. This acquisition will earn the province of BC close to $9.5 million over eight years. The company will spend an additional $12 million on exploration, part of which will go to hiring and training members of the Tahltan First Nation.

Western Churchill Metallogeny Project Assists Northern Mineral Exploration

Results from NRD's Western Churchill Metallogeny Project have stimulated mineral exploration in the north. International and Canadian companies are using these results to locate potential diamond exploration sites in Nunavut. In northern Manitoba, the world's premier diamond mining company acquired two million hectares of exploration licences two weeks after the release of new isotopic data that were generated jointly by the Manitoba Geological Survey and ESS. Marking a milestone, on August 11, 2004, the POLARIS consortium of academia and ESS scientists and technical staff announced the first real-time transmission of magnetotelluric data from northern Canada to an archive at ESS facilities in Ottawa. The maps generated with the POLARIS information will help to pinpoint potential diamond exploration areas.

3D Software Contributes to Significant Copper Discovery in Quebec

A Canadian mineral exploration and development company made a significant copper discovery using advanced 3-D modelling software developed jointly by the Geological Survey of Canada of ESS and Mira Geoscience. Developed under the NRD program, this new software allows geologists, geophysicists, geochemists and engineers to identify potential mineral targets by performing custom queries of geoscience data. The copper find is located 14 km northwest of the Horne smelter in the town of Rouyn-Noranda, Quebec, and Alexis made the discovery in early March 2005, after only four months of exploration. The 3-D modelling software is an extension to an existing commercial 3D package known as Gocad.

Dinosaur Footprints Discovered while Surveying for Energy Potential

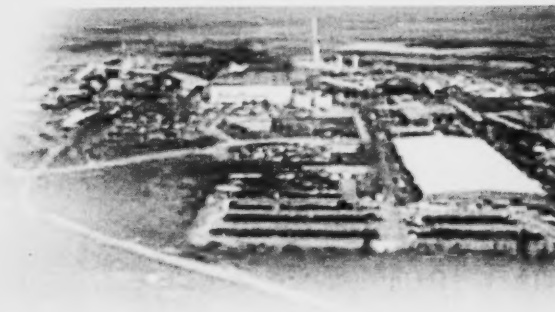
While surveying northwest B.C.'s energy potential in 2004, two geologists from the NRD program discovered that dinosaurs once inhabited this remote part of the province. They reached this conclusion after finding half a dozen three-toed footprints dating back to the Cretaceous Period, about 125 to 145 million years ago. The largest footprint—about 25cm long—belonged to a human-sized carnivore similar to a velociraptor. The discovery was made about 200 kilometres north of Terrace while working on a federal-provincial project to survey the Bowser and Sustut Basins for their energy potential. Aimed at stimulating industry activity in this energy prospective area, this NRD project will deliver new GIS-enabled maps, datasets, petroleum-resource assessments, and a digital basin atlas. This atlas will contain a synthesis of a new multi-thematic geoscience model that exploits a range of field and analytical studies.

Northern Stakeholders Field Workshop Held in Canada's High Arctic

In July 2004, ESS conducted a geological field workshop on Ellesmere and Axel Heiberg islands. It enabled participants from academia, industry, and government to get acquainted with one of Canada's richest hydrocarbon basins — the Sverdrup Basin of the Canadian Arctic Archipelago — at a time of rising interest in northern oil and gas exploration. The Geological Survey of Canada organized this NRD workshop in collaboration with the Polar Continental Shelf Project under the auspices of the New Energy Options for Northerners project.

The Targeted Geoscience Initiative

The Targeted Geoscience Initiative (TGI) stimulates sustainable economic development in Canada by encouraging private-sector exploration for energy and mineral resources in high-potential regions. It advances the Government of Canada's commitment to the sustainable development of our natural resources, contributing to their economic importance and to a strong society and communities through knowledge, innovation, technology, and international leadership. TGI produces new geological and geophysical maps and data for previously under-explored areas with a high potential for mineral deposits. All TGI projects are undertaken in partnership with provincial and territorial geoscience agencies, industry, and academia.



Funding Renewed for Five Years

Initially funded for three years in 2000, the success of TGI led to a two-year extension in 2003 to support energy and minerals-related geoscience. Over the past five years, TGI has helped federal, provincial, and territorial governments co-operate on geoscience issues and has also successfully encouraged private sector resource exploration. As a result, the Government of Canada renewed the Initiative for another five years in its 2005 Budget. TGI's third phase will focus on mapping to promote the discoveries needed to sustain base metal mining communities.

TGI Spurs Resource Exploration Across Canada

TGI was involved with several projects that led to substantial investment in resource exploration. For instance, a radiometric survey flown in the Toodoggone area, B.C., increased interest in exploring the region of the Kemess and North Kemess copper-gold porphyry deposits. Based on the survey results, a Vancouver-based mining company planned to spend more than $500,000 exploring the area in 2004. Influenced by results from TGI's Appalachian Energy project, in October 2004 a Québec-based oil and gas exploration company announced a three-year $5-million hydrocarbon exploration program involving 13 wells in eastern Gaspé.

Rising Uranium Prices Put Spotlight on Athabasca Basin Study Results

With uranium prices tripling in the last five years, the timing is right for a new study on the Athabasca Basin, which is due in mid 2005. The EXTECH IV Athabasca Uranium Multidisciplinary Study partners include ESS's Geological Survey of Canada, the governments of Saskatchewan and Alberta, Cameco Corporation, AREVA subsidiary COGEMA Resources Inc., and three universities. These partners contributed resources valued at $8 million to the study, including more than 80 scientists who worked on some 14 sub-projects. The timely 31-paper volume of study results will help industry, governments, and investors to make wise decisions for Canada's future and sustainable development.

High-Resolution Aeromagnetic Survey in Manitoba Produces New Maps

A high-resolution aeromagnetic survey covering the northern Assean Lake area in Manitoba produced 22 new aeromagnetic maps of the region. The new data provides valuable insights on the geology in a poorly exposed area between Thompson, Manitoba, and the northwest limit of the highly prospective Fox River Sill. Geologists used maps generated from the survey to better understand the structure of the area's rocks, which can carry nickel, copper and platinum deposits. Results from this survey will be used to enhance existing geological maps and to identify potential exploration targets.

Working Together to Influence Exploration

The Consolidating Canada's Geoscience Knowledge program completed several TGI 2 projects. Through these projects, the Geological Survey of Canada of ESS, together with several provincial surveys and industry, delivered an extensive series of maps and reports relating to energy geoscience in three areas: the Palaeozoic rocks of Ontario, the Williston Basin in Saskatchewan, and the Appalachian Mountains in Eastern Canada. In addition, a TGI 2 project between the Geological Survey of Canada and Saskatchewan focused on studying the complex kimberlite deposits in the province, influencing the region's diamond exploration programs. These maps and reports are essential to the success of private sector exploration, which in turn contributes to the economic and social well being of many rural and northern communities.

Geomatics for Northern Development

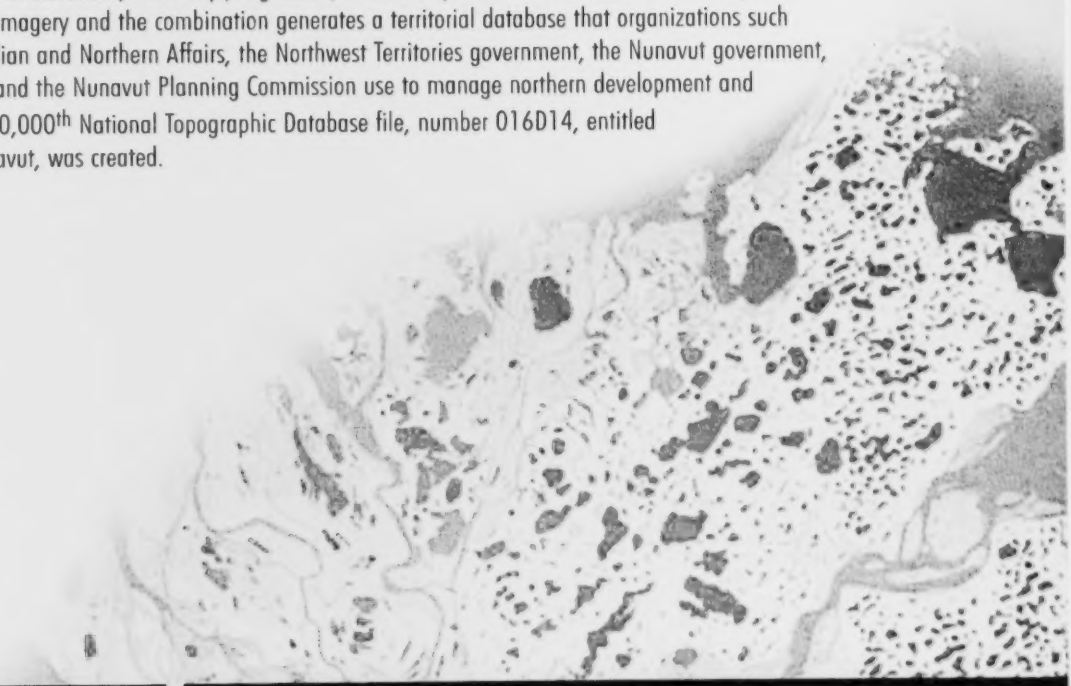
The Geomatics for Northern Development (GND) program of ESS provides northern communities with spatially related information to make better decisions, increase investment, and improve social and economic development. By providing geospatial information and knowledge, this program stimulates resource exploration and underpins infrastructure and land-use planning and capacity building by local government and communities in the North. For more information, please see http://gnd.nrcan.gc.ca.

Environmental Assessment Relies on Mapping Mackenzie Delta and Valley

A partnership with Indian and Northern Affairs Canada and the Northwest Territories government has given ESS the opportunity to help measure the potential impact of the Mackenzie pipeline. The GND program of ESS is providing expertise and quality control processes for production of quality geospatial data such as ortho-photos and digital elevation models. This information will be used in mapping the Mackenzie Delta and Mackenzie Valley, allowing federal and territorial agencies, communities, and various committees to better assess the pipeline's likely environmental effects.

New Topographic Data Used for Northern Land Management

In 2004, GND awarded more than $1.1 million in contracts to the Canadian geomatics industry for topographical mapping projects in Nunavut and the Northwest Territories. These mapping projects produce geospatial information about a particular area—its elevations, waterways, vegetation, and development. This information is then updated using Landsat7 satellite imagery and the combination generates a territorial database that organizations such as the Department of Indian and Northern Affairs, the Northwest Territories government, the Nunavut government, Nunavut Tunngavik Inc, and the Nunavut Planning Commission use to manage northern development and resources. In 2004 the 10,000th National Topographic Database file, number 016D14, entitled "Leopold Island" in Nunavut, was created.



Connecting Canadians

Canada is leading the world in building a virtual infrastructure to use geographic or geospatial information for the economic and social benefit of our citizens. The Earth Sciences Sector (ESS) is establishing important partnerships to develop and exchange innovative on-line geospatial content and services for policy and business decision-making. Using the Internet, citizens can now view geographic information about issues that are relevant to them and to the Government of Canada.

Geomatics for Connecting Canadians

Canadians are enjoying better access to ESS geospatial maps, data, services, and web-based applications through the Sector's Geomatics for Connecting Canadians (GCC) program. By making ESS geospatial information more accessible to clients on-line, the program enables a wider audience to use geospatial information and consequently contributes to more informed decision-making. It builds on the success of the Canadian Geospatial Data Infrastructure (CGDI) and furthers the contribution of ESS to this resource. The CGDI includes the technologies, standards, access systems and protocols necessary to harmonize all of Canada's geospatial databases, and make them available on the internet.

Revamped Atlas of Canada Improves Navigation and Accessibility

Based on input from Atlas of Canada users and thanks to the work of the GCC program, the new look and feel of the Atlas web site makes it easier to navigate and to find maps and related information about the country. In addition, the Atlas is also now fully accessible for people with disabilities who use assistive technologies. The Atlas of Canada is developed in collaboration with GeoConnections to help Canadians access geospatial information on the Internet. For more information, please visit http://atlas.gc.ca.

Geospatial Portal Responds to Clients

The GeoBase Portal celebrated its first anniversary with a makeover provided by the GCC program of ESS. In response to client feedback, the new and improved portal is faster to navigate and more reliable. A product of partnerships between the Canadian Council on Geomatics, GeoConnections, governments and industry, the GeoBase Portal ensures the provision of, and Internet access to, a common, up-to-date and maintained base of quality geospatial data for all of Canada. The GeoBase Portal, along with the GeoGratis web site and the Digital Topographic Data Distribution site of ESS, have delivered over 1.6 million geospatial datasets over the past year to fuel the growth of geomatics applications and services across Canada. Please see http://GeoBase.ca, http://geogratis.cgdi.gc.ca and http://www.ctis.nrcan.gc.ca.

User-centric Design Process Underlies GeoConnections Discovery Portal Improvements

The GeoConnections Discovery Portal provides Canadians with a convenient way to get geomatics data, tools and services through the Canadian Geospatial Data Infrastructure. The site is now easier to navigate, query, and apply thanks to an ongoing user-centric design process used by the GCC program. After defining business and user needs and testing prototypes, the first in a series of site improvements by GCC simplified access to satellite images, topographic data, and aerial photographs. The next phase of site improvements will involve categorizing web services and bolstering content according to user needs. For more information, please visit http://geodiscover.cgdi.ca.

Aboriginal Peoples

The Earth Sciences Sector (ESS) is contributing to better knowledge and understanding of northern communities and the Aboriginal peoples who live in them by providing new maps, training, technology, and procedures for changing place names. The Sector also provides rural, Aboriginal, and northern communities with the tools and training to use modern mapping technologies for informed sustainable development decisions. Reliable and consistent geospatial information and well-defined property rights are an important part of development and investment in the North and the people who live there.

Geomatics for Aboriginal Property Rights Infrastructure

The Geomatics for Aboriginal Property Rights Infrastructure (GAPRI) program of ESS provides fundamental governance support to the First Nations' devolution process and contributes to the economic and social success of Aboriginal people. The program accomplishes these results by delivering and promoting a robust, reliable, and flexible property rights infrastructure. By ensuring that the extents of rights in land are well defined and that related land information is accessible and securely managed, this program supports investment in communities and sustainable development. The infrastructure supports other land-management activities, such as land-use planning and environmental protection.

Funding to Define Property Rights on Aboriginal Lands

ESS and Indian and Northern Affairs Canada (INAC) signed several interdepartmental letters of agreement related to the GAPRI program. These agreements, along with incremental funding, allocated $8.83 million to support 14 GAPRI-related projects. These projects dealt with the boundary or cadastral component of property rights on existing or proposed Aboriginal lands. GAPRI works in collaboration with INAC, Aboriginal communities, and Aboriginal institutions such as the National Aboriginal Land Managers Association, the First Nations Land Management Act, Lands Advisory Board, and Indian Oil and Gas Canada. In addition, the Association of Canada Lands Surveyors continues to be a key partner by supplying professional geomatics services.

Project to Streamline Land Ownership on First Nation Reserves

GAPRI's Capacity Building—Cadastral Reform Project is a joint venture with INAC to integrate the Canada Lands Surveys Records with the Indian Land Registry. This project will provide a more efficient land transaction process, increase integrity in the land tenure system on First Nation's Reserves, reduce liability to the Crown, support the First Nations Lands Management Initiative and other self-government initiatives, and encourage more informed decision making by improving access to data at all levels of government. Recognizing the importance of this undertaking, both ESS and INAC have added resources and advanced milestones to complete the project ahead of schedule.

Working Towards Completing Land-claim Surveys

Progress continued on land surveys pertaining to the three comprehensive land claims in the North: the Nunavut Tunngavik land claim, the Sahtu Dene Métis Comprehensive Land Claims, and the Council for Yukon First Nations Comprehensive Land Claims. In addition to these claims, a new Land Claim and Self Government Agreement—the Tlicho, or Dogrib, claim in the Northwest Territories—was recently ratified and work on this claim should start in 2005-2006. ESS also worked on a small comprehensive claim in British Columbia.

Atlantic Client Liaison Unit Participates in Innu Healing Strategy

The Atlantic Client Liaison Unit (CLU) in Amherst, Nova Scotia, was involved in the Innu Healing Strategy, which has received national and international exposure. The unit was asked by INAC to participate on a team addressing the creation of an Indian Reserve for the community of Sheshatshiu. The Innu felt that this Indian Reserve would give them the tools they need to take charge of certain aspects of their healing. Working with INAC, Newfoundland and Labrador, Justice Canada, and the Innu to transfer private and crown lands that made up the entire village of Sheshatshiu, the CLU created a number of specialized maps and legal surveys. They also provided professional advice about the extent of the current property rights interests in the village.

ESS International Activities

ESS International Trade and Investment Activities

Canada's Earth sciences and geomatics industries are major contributors to the Canadian economy and key players in the global market. Their comparative advantage is demonstrated by competitively exporting products and services. The International Division and the Global Opportunities program (GOP) of the Earth Sciences Sector (ESS) work closely together to maximize the effectiveness of the Sector's international work and to reinforce Canada's knowledge, technology, leadership and influence in the area of earth sciences.

The International Division of ESS leads, coordinates and monitors the Sector's international trade and investment activities and promotes the use of Canadian earth sciences knowledge and technology overseas in partnership with the Canadian private sector. This work is complemented by the Global Opportunities program (GOP), which manages international projects that address priority issues of developing countries. This program coordinates ESS participation in externally funded international development projects where earth sciences can contribute significantly to social, economic, and sustainable development. For more information on ESS international activities and GOP, please see http://ess.nrcan.gc.ca/intl/intl_activities/index_e.php and http://ess.nrcan.gc.ca/pri/int_e.php.

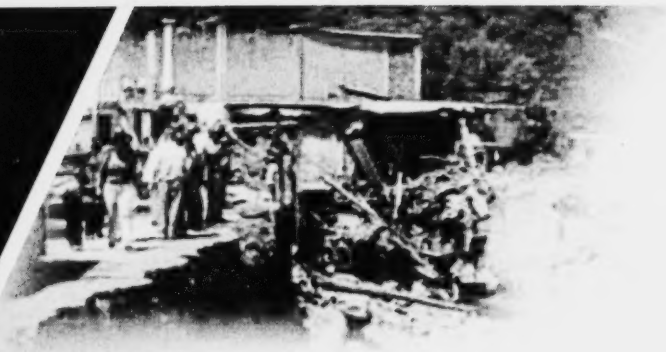
CHINA

Successful Mission to China

The Assistant Deputy Minister (ADM) for ESS, Dr. Irwin Itzkovitch, and the ADM of the Minerals and Mining Sector, Gary Nash, represented NRCan at the China Mining Congress and Exhibition in November, 2004. This visit aimed to enhance relationships with Chinese earth sciences institutions and further promote earth sciences projects, including mutually beneficial business opportunities. As a result, Letters of Intent were signed with the Chinese Ministry of Water Resources for cooperation in groundwater and remote sensing applications and also signed with the China Geological Survey to help develop joint projects and open the way to a future Memorandum of Understanding (MOU). An Annex on Investigation of Earthquake Precursors was also agreed to under an existing MOU with the China Earthquake Administration. In particular, the groundwork was laid for Minister Peterson of International Trade Canada to sign an MOU for collaboration in earth sciences with the Ministry of Land and Resources during the Prime Minister's trip to China in January 2005.

Cooperation in the Canadian and Chinese Oil and Gas Sector

In addition to the trade mission, GOP recently launched the ESS-China Hydrocarbon Geoscience Collaboration Project. It contributes to producing sustainable clean energy by bringing together the oil and gas sectors from two of the world's largest countries. ESS is working with the China National Petroleum Corporation, the Chinese Academy of Sciences, the China Petroleum University, and the Canadian geoscience community to develop petroleum system models and exploration technologies to extract unconventional oil and gas resources. This project will also conduct laboratory tests and field workshops to develop new geological and geochemical constraints of basin models that are essential for mapping undiscovered petroleum resources in both Chinese and Canadian basins. As conventional hydrocarbon resources decrease, Canada and China can benefit by working together to secure future energy supplies from non-traditional hydrocarbon sources.



THE AMERICAS

Geomatics Trade Mission to Mexico

Led by Dr. Irwin Itzkovitch, ESS showcased Canadian excellence in the application of geomatics technologies through presentations and meetings at the United Nations-International Federation of Surveyors (UN-FIG) Special Forum on Latin America held in Aguascalientes, Mexico, in October, 2004. This forum addressed benefits and concerns related to the effective development and use of Spatial Data Infrastructure. After the forum, ESS representatives met with other organizations in Guadalajara and Mexico City. Initial benefits of this mission are the establishment and strengthening of relationships between Canadian firms and their counterparts in Latin America. In addition, ESS gained a better appreciation of Latin American geomatics priorities and technologies and enhanced their awareness of the ESS expertise required to further develop Canada-Latin America collaboration and business.

Geoscience Project Lessens Impacts of Natural Disasters in the Andes

The Multinational Andean Project: Geoscience for Andean Communities (MAP:GAC) is improving the quality of life in the Andean nations of Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, and Venezuela by reducing the effects of earthquakes, landslides, and volcanoes. To achieve this goal, more than 32 workshops were conducted covering topics such as communicating science to non-scientists, natural hazard risk awareness, remote sensing, landslide methodology, web-based digital libraries using a distributed network, and shallow geophysics. Before the CIDA-funded project started, the geoscience surveys of Bolivia, Ecuador, and Venezuela did no geological hazard work. However, with the support of MAP: GAC, each of these countries now has competent practitioners working on projects of national importance. Another major accomplishment of the project includes an agreement between the Iberoamerican Association of Civil Defense and Civil Protection agencies and MAP: GAC to work together to provide communities with better hazard information and mitigation strategies.

Global Benefits Expected from Northeastern Brazil Groundwater Project

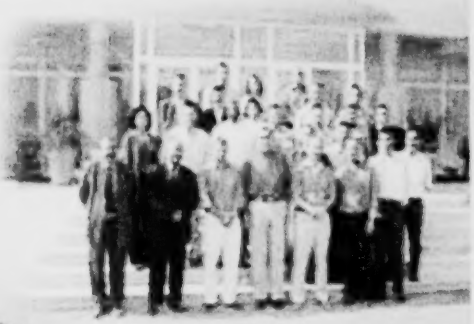
The CIDA-funded Northeastern Brazil Groundwater project (*Projeto Agua Subterrinea no Nordeste do Brasi* — PROASNE) concluded in 2004 to the satisfaction of its Brazilian and Canadian partners, including ESS. Operating in four semi-arid pilot areas in the states of Ceará, Pernambuco, and Rio Grande do Norte, this technology transfer and capacity-building project contributed to the sustainable development of Brazil's groundwater resources. PROASNE used airborne electromagnetic methods to rapidly map geological structures that control the occurrence of groundwater in granitic bedrock and applied Canadian solar technology to manage groundwater resources. It also developed a national interactive groundwater database and information system that is accessible via the Internet and is now being implemented in Brazil. This database has generated important spin-off revenues for the Canadian company involved in its creation. The knowledge gained from this project is serving as a model for the growing worldwide water-resources development market.

AFRICA

Applying Geomatics Expertise to Improve Africa's Resource Management

ESS has been actively involved with African nations in many capacities over the past year. In September 2004, the Executive Secretary of the Sahara and Sahel Observatory (OSS), Mr. Youba Sokona, met with the Assistant Deputy Minister of ESS, Dr. Irwin Itzkovitch, to discuss implementation of geomatics training on water management and environmental protection. The OSS provides a framework for exchanging information used to combat desertification and lessen the effects of drought. As well, ESS representatives established relationships with a number of other regional organizations and funding agencies to pursue opportunities to help companies enter new markets and to help African countries address their sustainable development issues.

The increased emphasis on Africa is building on the Sector's success in Tunisia as part of its GOP GEONAT project to help Tunisia establish a national geomatics infrastructure. Working with the Canadian private sector, ESS presented the Tunisian government with a strategic plan to implement a national geomatics program. Following the plan's acceptance, managers, leaders, and decision-makers attended information sessions that described geomatics and its potential use in Tunisia. In addition, managers from various Tunisian government departments received geomatics training through the University of Laval and Cégep Limoilou.



Services

Earth Observation Data Services (EODS)

This service provides Earth Observation (EO) data to ESS programs, the Canadian Space Agency, other government departments, the private sector and other users. The EODS ground segment infrastructure of the Canada Centre for Remote Sensing (CCRS) provides North American data reception coverage capability. Its ground stations receive EO data from several satellite sensors and maintain archives dating back to 1972. Data is available to support near-real-time applications such as forest-fire monitoring and mapping, natural hazards, and ice monitoring. These data also support non-real-time applications in sustainable development, including resource and land use management and climate change.

High use of EO Satellite Imagery Reception, Archiving & Dissemination

LANDSAT data continues to be heavily used by Canadian government departments and ESS programs. RADARSAT-1 operations for the Canadian Space Agency continued to meet or exceed requirements. ENVISAT near-real time services continued to be provided to the Canadian Ice Services of Environment Canada and services were successfully provided to the Northern View team of the European Space Agency's Global Monitoring for Environment and Security project. ERS-2 data reception services continue to be successfully provided to the European Space Agency to satisfy global dataset requirements.

New AVHRR Dataset for Climate Change Studies

EODS produced a historical Advanced Very High Resolution Radiometer (AVHRR) dataset for the Reducing Canada's Vulnerability to Climate Change program of ESS. This dataset will be used to produce parameters for a number of measurements: surface reflectance, normalized difference vegetation index, leaf-area index, snow-ice cover, land-cover, and ecosystem productivity. Other government departments and agencies have expressed interest in obtaining this same historical dataset for their purposes. For instance, the Department of Fisheries and Oceans is interested in using the data to support its research on sea surface temperatures.

New Canadian EO Satellite Acquisition Management System Up and Running

MacDonald Dettwiler and Associates developed a new $960,000 Canadian Earth Observation Satellite Acquisition Management (CEOSAM) system for CCRS of ESS. Funded by the Canadian Space Agency as part of a three-year RADARSAT-2 ground segment development project, the system will be used to accept user orders for receiving satellite data, interface with satellite operating agencies, perform acquisition and reception planning including conflict resolution, and receive post-pass reception reports. This highly automated system improves satellite acquisition performance and reduces operating costs.

New Data Acquisition and Facility Control System Operational

MacDonald Dettwiler and Associates developed a new Data Acquisition Facility Control (DAFControl) system for CCRS of ESS. The Canadian Space Agency, as part of its three-year RADARSAT-2 ground segment development project, funded this $1.9 million system. DAFControl receives satellite reception schedules from Satellite Acquisition Services (SAS), tasks and controls all reception and archiving equipment, and sends post-pass reception reports to the SAS. By better automating these processes, the DAFControl system improves performance and lowers operating costs.

Canadian Geodetic Service

The Canadian Geodetic Service (CGS) of ESS maintains the Canadian Spatial Reference System (CSRS) as a national standard for all positioning information in Canada. This associated reference frame for latitude, longitude, height, and gravity serves as the foundation for spatially referenced information systems and related geoscience needs. Maintaining the CSRS involves monitoring the Earth's rotation and tectonic movements for determining related time-variable parameters that are implicated in global climate change, meteorology, and space sciences.

GPS Observations Provide Evidence of Crustal Motion in Eastern Canada

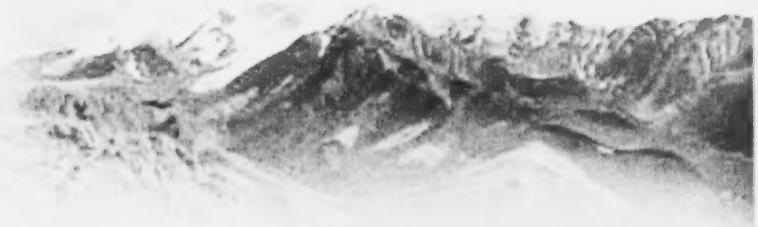
Global positioning system (GPS) observations from the Canadian Base Network (CBN) reveal a consistent pattern to the vertical movement of the Earth's crust in Canada. These crustal movements are a delayed response to the retreat of the last ice age. The observations reveal that the crust is consistently lifting by as much as a centimetre a year near Hudson Bay and sinking by a few millimetres a year near the Central U.S. border. This insight improves our understanding of sea level and lake-level changes—a key to understanding the effects of climate change. The GPS-derived pattern of horizontal crustal motions also helps us understand earthquakes in eastern Canada.

Users Locking on to Precise GPS Positioning Internet Service

Use of the new Internet GPS Precise Point Positioning service is rapidly increasing. This on-line service provides accurate, CSRS-compatible latitude, longitude, and height coordinates. Unlike traditional GPS positioning techniques, the new service works using data from a single GPS receiver without the need to find or occupy conventional geodetic control points. This freedom makes GPS positioning more efficient, reducing costs for both users and ESS. Users simply submit their GPS receiver data files, and the service automatically produces accurate coordinates. This novel approach makes it possible to connect to the CSRS from anywhere in Canada—a particular benefit in remote regions.

CGS Shares Expertise to Transform Data and Prepare for Future

CGS of ESS provided expertise to the City of Toronto to transform its legacy spatially-referenced data into the latest globally consistent national spatial reference system. During the last few years, CGS has helped a majority of provincial jurisdictions conduct this same process. Moving to this reference system not only simplifies the use of GPS technologies for generating and using spatially-related information, but also facilitates the sharing and integration of geospatial data across organizations.



Geodetic Expertise and Infrastructure Plays Role in Innovation for Canada's Future

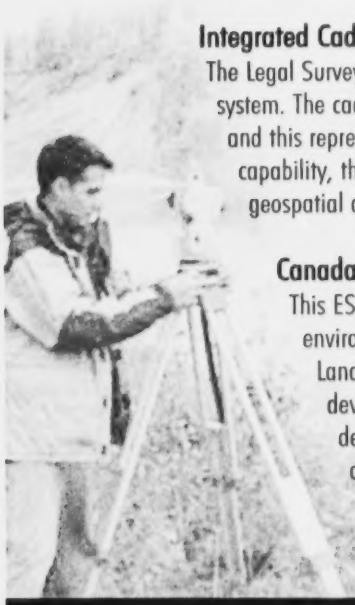
CGS is a partner in five projects recently announced by the Geomatics for Informed Decisions (GEOIDE) National Centre of Excellence. CGS will lend both expertise and infrastructure to these projects, which promise numerous practical benefits to Canadians. Two projects will prepare for changes that the imminent launch of Europe's Galileo System, or GPS III, will bring to positioning and navigation applications in Canada. Two other projects are investigating the use of space geodetic techniques for monitoring the Earth and mapping the oceans, which could lead to a better understanding of climate change and natural hazards. Another CGS project will study the use of GPS technology for a national vapour-estimation system that could play a role in weather forecasting.

Canada Lands Survey System

By operating and maintaining the Canada Lands Survey System (CLSS) within ESS, the Surveyor General of Canada protects the interests of the Government of Canada, which owns the vast majority of Canada Lands. These lands are defined in the Canada Lands Surveys Act and include approximately 2,600 Indian Reserves, the National Parks system, the off-shore areas of Canada, and both private and Crown lands in the Yukon, Northwest Territories, and Nunavut. The primary objective of the Canada Lands Survey System is to provide the foundation to establish property rights on Canada Lands by defining, describing, and documenting the extent of all land interests.

Users to Gain from CLSS Benchmarking and Best Practices

Legal Surveys Division of ESS is establishing a point of reference for the CLSS. This point of reference will help the CLSS better meet the needs of its users and serve as a worldwide best-practices model. In October 2004, a Legal Surveys Division task force developed eight principles that will guide this benchmarking exercise. Among these principles are: provision of an effective property rights infrastructure, allowing users to view the extent and nature of all property rights and restrictions, and simplification of adopting standards for a national cadastral data model based on the Canadian Geospatial Data Infrastructure.



Integrated Cadastral Management Project to Produce Land-Information Reference

The Legal Surveys Division of ESS has embarked on a project to develop an integrated cadastral management (ICM) system. The cadastre will use geospatial information to reliably represent legal surveys and registered land tenure, and this representation will provide users with a base to reference other land-related information. To deliver this capability, the ICM project will review, develop, and recommend improvements to business processes and to geospatial data models and geographic information systems tools that support the strategy of ESS.

Canada Boundary Management and Property Systems Program

This ESS program is designed to deliver the key elements of the CLSS in a cadastral management environment, which will be integrated with other components of the property rights systems on Canada Lands. The program will develop a new cadastral management framework that supports northern development, First Nations self-reliance, management of Canada's ocean space, sustainable development of natural resources, and cadastral institutional reform initiatives for developing communities. In addition, the program will provide the infrastructure required to support a national cadastral data layer for Canada on the Canadian Geospatial Data Infrastructure. This layer will provide access to socio-economic information related to the cadastral parcel.

National Initiatives and Partnerships

GeoConnections

2004-2005 represented the last year of the initial funding for GeoConnections. Since its inception in 1999, this national partnership initiative has built the foundation of policies, standards, protocols, technologies, and partnerships required for Canadians to benefit from easy on-line access to geographic data, services, and applications via the Canadian Geospatial Data Infrastructure (CGDI).

All levels of government, the private sector, academia, and non-government organizations have worked together to build the CGDI and in turn contribute to the Canadian economy, society, and environment. For example, GeoConnections' leadership helped governments across Canada to integrate their geomatics activities by encouraging them to work together and by developing policies and standards for efficiently sharing and using data.

GeoConnections also contributed to Canada by helping build geomatics capacity in rural, coastal, Aboriginal, and northern communities. These communities can now use geomatics to support socio-economic growth and make informed decisions about sustainable development. If Canadians know how to capitalize on geomatics tools such as geographic information systems (GIS) and global positioning systems (GPS), they are much better equipped to plan their communities, manage natural resources, protect the environment, and safeguard their health.

In addition, GeoConnections helped build awareness of geomatics in secondary and post-secondary schools, and nurtured the skills of qualified people to help the Canadian geomatics industry fulfill its vast potential.

Today, thanks to GeoConnections, numerous groups of users with distinct requirements are also discovering the benefits of geospatial information – in the fields of real estate, school administration, and public health, among others.

These are a few of the many GeoConnections' activities in 2004-2005. For more information, please visit http://www.geoconnections.org/CGDI.cfm.

Moving Confidently Into the Future

On February 23, 2005 the federal government tabled its 2005 Budget and demonstrated its commitment to continue building the CGDI and promoting its use, particularly in key priority areas such as health, public safety, sustainable development and the environment, and issues of importance to Aboriginal people. By investing $60 million over the next five years for the continuation of GeoConnections, the federal government intends to maintain the momentum that the first GeoConnections initiative achieved and to continue leveraging the efforts of partners.

Partnering With Industry to Spur Technology Development

Through GeoConnections, the Government of Canada has helped geomatics technology projects leverage other contributions and get off the ground. In fact, since its inception, GeoConnections has provided more than $11 million to Canada's geomatics industry through its GeoInnovations program. Combined with contributions from other partners, that funding has resulted in technology projects valued at more than $32 million. For instance, in 2004, GeoTango International Corp. worked with GeoConnections to create a more intuitive way to explore, analyze, and understand complex geospatial data. The tool they developed, *GSN 3D Explorer,* allows users to visualize and analyze geography markup language (GML) data in three dimensions. Another company, CubeWerx Inc., developed security software in 2004 that lets organizations minimize the costs to adopt, administer, and participate in web-enabled and secure collaborative geospatial information infrastructures such as the CGDI. These, and many other projects have developed advanced CGDI technologies and applications that better equip Canadians to access and use geospatial data.

Enriching Community Decision Making

Through its Sustainable Communities Initiative (SCI), GeoConnections has launched 109 projects involving more than 250 rural and remote Canadian communities to help them apply GIS to administer community resources and development effectively. Working with SCI, these communities learned how to use GIS and digital maps to address specific community challenges. For instance, Bearskin Lake is an isolated First Nation community about 400 km north of Sioux Lookout in north western Ontario. In 2004-2005, SCI trained two community members to use desktop GIS software as part of a resource-development program, including a five-year land-use management plan. In Saskatchewan, three members of the Kawacatoose First Nation community were trained to use GIS and global positioning systems (GPS) to develop a land-tracking system. This system will help the community develop organic-based agriculture on its recently expanded land holdings.

GeoConnections also worked with a number of communities of practice representing key public priorities. For example, GeoConnections partnered with the Winnipeg School Division and DMTI Spatial Inc. to develop an on line Housing Registry based on the CGDI to help inner-city families find new accommodation within their existing school zones. This tool will help parents avoid unnecessarily transferring their children to different schools, a disruptive practice that often impedes youth education and social well-being.

Improving Access to Free Quality Data

GeoBase is a collection of current, accurate geospatial data about Canada—roadways, administrative boundaries, and other geographic characteristics. It delivers on the framework data commitments of the GeoConnections initiative, which is itself a key contributor to GeoBase. By 2005, the National Road Network (NRN), one of six GeoBase themes, blanketed Canada – a 133% increase in coverage in a little over a year. GeoBase now houses accurate, consistent, and up-to-date information about every highway, thoroughfare, street, boulevard, crescent, avenue, and cul-de-sac in the country. GIS developers can use this roadway data to build GPS- or web-based applications and integrate this layer and any, or all, of the other five GeoBase data layers to produce perspectives far more valuable than any one data layer would offer alone.

Climate Change Impacts and Adaptation Program

The Climate Change Impacts and Adaptation Program (CCIAP) is a national initiative designed to generate greater knowledge about Canada's vulnerability to climate change. By filling gaps that limit our understanding of vulnerability, the program equips Canadians to better assess the risks and benefits posed by climate change and to make informed decisions about adapting to its impacts. CCIAP also assesses the latest science related to impacts and adaptation, encourages stakeholders and researchers to collaborate, and facilitates climate change policy development. For more information, please see http://adaptation.nrcan.gc.ca.

Research Projects Study Climate Change Impacts across Canada

CCIAP funded 32 new research projects across Canada in 2004-2005. These projects dealt with a variety of issues including water resources, fisheries, agriculture, non-commercial food supplies, and human health and well-being. For instance, researchers investigated the vulnerability of groundwater supplies in Prince Edward Island, they studied the impacts of climate change on Arctic char in the North, they examined strategies to deal with drought in the Prairies, and they assessed the role that local ecological knowledge can play in adapting to changing food supplies in northern B.C.

Climate Change Policy Coordination and Networking

Through CCIAP, ESS is coordinating the development of climate change policy and addressing gaps in our knowledge of Canada's vulnerability to climate change. By leading the development of the National Adaptation Framework, ESS helps governments work together to increase Canada's capacity to adapt to climate change. The framework's objective is to equip Canada to recognize and reduce risks associated with climate change and to capitalize on any opportunities that climate change offers. The CCIAP also coordinates the Canadian Climate Impacts and Adaptation Research Network (C-CIARN). This national network of 13 regional and sectoral coordinating offices has more than 2,650 members and brings researchers together with decision-makers from industry, governments, and non-government organizations to improve our knowledge of climate change and its potential impacts.

Report Presents Overview of Climate Change Impacts and Adaptation in Canada

In August 2004, CCIAP released *Climate Change Impacts and Adaptation: a Canadian Perspective*. CCIAP distributed more than 8,000 paper and CD copies of this report to federal, provincial, and territorial government officials, researchers, municipal and private industry decision makers, and other interest groups. The report will also serve as a primer for the next national assessment of climate change impacts and adaptation in Canada. The report is available at http://adaptation.nrcan.gc.ca/perspective_e.asp.

Polar Continental Shelf Project

Polar Continental Shelf Project (PCSP) is a national service delivery agency that coordinates logistics support to Canadian government agencies, northern land claims, northern communities, and independent and university groups conducting research in Canada's Arctic. Support is also provided on a full cost-recovery basis to private sector and non-Canadian researchers. Researchers receiving logistics support from PCSP have helped to define Canada's off-shore limits; establish Canada's claims to off-shore hydrocarbon and mineral resources; identify safe shipping routes into northern communities; establish National Wildlife Areas and Migratory Bird Sanctuaries to protect and conserve wildlife habitats; identify pollution sources and their effects on the northern food chain; and to preserve and record the traditional knowledge of the North's Aboriginal inhabitants. For more information, please see http://polar.nrcan.gc.ca.

In 2004 - 2005, PCSP provided $4.5 million in efficient and cost-effective logistics services to approximately 125 projects researching, for example, archaeology, anthropology, biology, botany, climate change, ecosystem assessments, oceanography, and geology.

Through its ongoing Traditional Knowledge Program, PCSP also provided support to three community-based cultural programs. These included the Vuntut Gwich'in First Nation oral history project; the Iqaluktuuq Project researching long term Inuit cultural history; and the Igloolik Inullariit Elders Society traditional skills camp to equip their youth with the essential skills needed to survive and live on the land.

Group on Earth Observation

The Group on Earth Observation (GEO) initiative is an international initiative to build a comprehensive, coordinated and sustained Earth observation system of systems. By continuously collecting high quality and timely worldwide data, the many participating nations will be able to gain a deeper understanding of dynamic Earth processes, better predict events of nature, and further implement environmental treaty obligations.

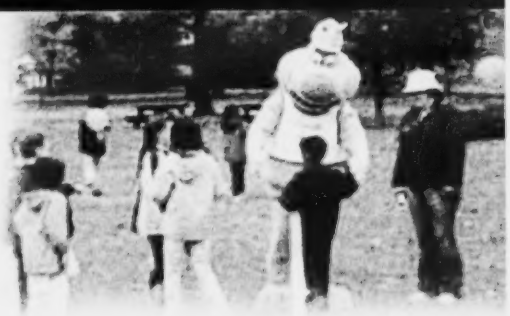
In 2004, delegates at the fifth meeting of the *ad hoc* intergovernmental GEO agreed on a 10-year implementation plan to create a Global Earth Observation System of Systems (GEOSS). Built on a worldwide network of in-situ and remote-sensing devices, GEOSS aims to maximize the effectiveness of earth observation by minimizing data gaps and exchanging information as fully and quickly as possible. This information can be used to improve human health and safety, minimize poverty, protect the environment, and reduce losses resulting from disasters. ESS has been instrumental in the development of the GEOSS international user-interface mechanism. Canada has been a very active participant in the development and adoption of the implementation plan and the Earth Sciences Sector is leading NRCan's contribution to GEO. For more information, visit http://earthobservations.org.

Innovation Acceleration Centre

Established in 2001, the Innovation Acceleration Centre (IAC) is a model for the federal government to assist Canadian companies to develop and commercialize geomatics and geoscience products and services. After being selected through a competitive process, successful IAC companies are mentored either on-line or on-site by ESS experts and have access to federal knowledge and facilities.

The IAC has resulted in significant sales in new geomatics products and services, ranging from mineral exploration to advanced satellite image analysis technologies. Successful projects have resulted in multi-million dollar investments, sales and savings. A major product update from PCI Geomatics including IAC-based technology is to be released soon and a significant new international contract has been won by Vexcel Canada, a new participant. In 2004-2005, four new companies – Consultants TGIS (Montreal), Radarsat International, Noetix and ANF Energy Consultants (Ottawa) – were selected to join the 16 companies already participating in the IAC.

Outreach



NRCan Celebrates National Science and Technology Week

Led by ESS, this year's National Science and Technology Week (NSTW) was a great success. In the National Capital Region on Sunday, October 17, more than 150 NRCan employees volunteered at the Science Funfest open house, which attracted more than 4,000 visitors. Throughout the week, NRCan representatives gave science presentations to some 900 students and teachers. The Honourable John Efford, Minister of Natural Resources, launched the Government of Canada's Science.gc.ca web portal during a Geoscience Awareness Day held at the Canadian Museum of Nature. The day also featured science presentations from NRCan, Health Canada and the Museum of Nature, with guest speakers Dr. Arthur Carty, Science Advisor to the Prime Minister, and the Discovery Channel's Jay Ingram. Attendees included students from across Canada taking part in the 'Encounters with Canada' program.

Many of NRCan's regional offices opened their doors to the public and held a number of events to celebrate NSTW. The GSC office in Vancouver organized a series of "Rock Walk Talks"—one-hour tours of the urban geology around the Robson Street Office. Students, teachers, and clients who visited the office participated in rock-identification contests and scavenger hunts, and the winners received prizes and certificates. The office also held educational sessions such as "Mapmaking 101" and showed students a series of videos relevant to the earth sciences. In collaboration with Parks Canada, GSC employees in Quebec held geological field excursions in Old Quebec City and Montmorency Falls. The Centre for Topographic Information in Sherbrooke opened its doors to the community. Visitors were welcomed to Earth observation demonstrations at the satellite receiving stations in Gatineau, Quebec, and Prince Albert, Saskatchewan. Several events took place in conjunction with the Corporation of Delta and the Tsawwassen First Nation to highlight NRCan's work on climate change and natural hazards. In the Yukon, several ESS scientists were on hand to answer questions on their research during an event organized by the Climate Change Impacts and Adaptation Directorate.

Responding to the Indian Ocean Earthquake and Tsunami

Scientists from the Natural Hazard and Emergency Response program of ESS responded to the many requests for media interviews and public talks after the major earthquake and resulting tsunami in the Indian Ocean on December 26, 2004. For example, Garry Rogers (ESS) and Fred Stephenson (Department of Fisheries and Oceans) took part in two information sessions about the potential geohazards along the Cascadia Subduction Zone for concerned citizens on the Saanich Peninsula of British Columbia. Within days, they also participated in a workshop for a large group of first responders and representatives from emergency-related agencies. "Earthquake and Tsunami Hazard on Canada's West Coast", was a free public lecture given by the same ESS experts to a capacity audience at the National Geographic IMAX© Theatre in Victoria. This lecture was organized and the venue donated as a public service by the Geological Association of Canada and the Centre of Earth and Oceans Research (University of Victoria).

Popular "Day After Tomorrow" Climate Change Talk in Yellowknife

A capacity audience in the north heard Dr. Benoit Beauchamp give a talk entitled, *'The Day After Tomorrow' Happened 280 Million Years Ago: Should We Fear Abrupt Climate Change in the Future?*, where they were reassured that although climatic shifts have occurred in the past, they are not as rapid as portrayed in popular movies. This 'Charles Camsell Talk' was sponsored by the NWT and Nunavut Chamber of Mines and took place during the Yellowknife Geoscience Forum.

'Peopling of the Americas' Lecture Draws Substantial Audience

Dr. Lionel Jackson of ESS, and Dr. Michael Wilson, an archaeology and earth science scholar at Douglas College, presented a well-attended free public evening lecture at Vancouver's H.R. MacMillan Space Centre Auditorium in December, 2004. Entitled "The Ice-Free Corridor and the Peopling of the Americas—An Open and Shut Case", this event was organized by the Cordilleran Section of the Geological Association of Canada and highlighted the contributions made by GSC scientists over the past 100 years.

GSC Participates in "The Word on the Street" Festival

In September 2004, the GSC's Map and Publication Sales office in Vancouver participated for the first time in the popular, local, annual 'Word On The Street Festival'. Staff at the ESS booth sold geoscience publications, answered earth science related questions and made hundreds of contacts among teachers, geology enthusiasts and the public.

Raising Awareness of Climate Change Impacts in the North

Last fall, the Climate Change Impacts and Adaptation Directorate organized lunchtime screenings for large, appreciative audiences of *Arctic Mission*—a series of five award winning National Film Board documentaries that explore the impact of global warming on Canada's North. NRCan's Parliamentary Secretary and Member of Parliament for Yukon, Larry Bagnell, introduced the screening of the first documentary in the series. This initiative has helped raise awareness of the impacts of climate change on Canada and the roles of adaptation in addressing them. In December 2004, the Climate Change Impacts and Adaptation Directorate organized a lunchtime screening of *People of the Ice*, the fourth episode of the Arctic Mission documentary series. Mr. Bagnell, gave the opening address to a large gathering.

Educational Posters

Two of the latest posters in the highly successful 'Geoscape' series from ESS were launched on Earth Day, April 22, 2004. *Geoscape Ottawa-Gatineau: Living with our geological landscape* is a large, colourful poster produced by the GSC and its provincial, municipal and academic partners. *Geoscape Southern Saskatchewan: Geoscience for Prairie communities* was also unveiled on Earth Day by Minister Eric Cline, Department of Industry and Resources, Saskatchewan, at a school in Regina. All of the posters in the series use diagrams, maps, and photographs to illustrate how geological events shaped the landscape, resources, and natural hazards of Canadian regions. For more information, visit http://www.geoscape.nrcan.gc.ca.

The Groundwater program of ESS published two 'Waterscape' posters and related web sites to promote water stewardship and science-based decision-making. *Waterscape Bowen Island: water for our island community* and *Waterscape Gulf Islands: protecting and conserving our island water* can be downloaded through the Waterscape web site at: http://geoscape.nrcan.gc.ca/h2o/index_e.php.

GeoConnections, the Calgary Geomatics Cluster and the University of Calgary developed a highly successful series of six posters to raise the awareness of geomatics among Canadian students. These colourful posters illustrate how geomatics is used to address challenges in such areas as natural resources, the environment, agriculture, health, business, and government. In 2004, almost 5,000 complete sets were mailed to secondary and post-secondary schools across Canada and many more were handed out at National Science and Technology Week events across Canada. To order copies, visit http://www.discovergeomatics.com.

Climate change is a popular topic in Canada's classrooms. Consistently high demand prompted reprints of a series of posters that depict the effects of regional climate change in Canada. ESS has distributed some 120,000 of these posters, not only to schools, but also to universities, provincial and municipal governments, non-governmental organizations, and industries throughout the country. Visitors to the Climate Change Impacts and Adaptation program's web site can view the posters and order them at http://www.adaptation.nrcan.gc.ca or by calling 1-800 O-Canada.

Teaching the Teachers

In late September 2004, at the invitation of the Fort Vermilion School District, Godfrey Nowlan and Rod Smith of the GSC Office in Calgary conducted a workshop for teachers in High Level, Alberta. Addressing the Grade 7 'Planet Earth' unit of the science curriculum, this workshop is part of a larger outreach effort associated with various Northern Resource Development program projects designed to raise community awareness of geoscience's importance to daily life.

Two day-long geoscience workshops for Grade 10 science teachers were held in Victoria and Kelowna during late October 2004. As part of a province-wide professional development day, these teachers received various *Geoscape* posters and the *'Temperatures rising'* poster from the Climate Change Impacts and Adaptation Program to take to their students. Funded by EdGEO, a national initiative of the Canadian Geoscience Council, the workshops were delivered with the help of GSC volunteers. This partnership between the GSC and EdGEO to "teach the teachers" has proved to be an efficient way to increase geoscience literacy across the country.

Awards and Honours

Mapping Services Branch has won the Association of Professional Executives of the Public Service of Canada (APEX) Award for the second year in a row in the category of Leadership in Service Innovation. This year's award recognizes the federal, provincial, and territorial team associated with the GeoBase Portal (www.geobase.ca), which is hosted and managed by ESS and supported by GeoConnections.

NRCan's Earth Science Sector, Elections Canada, and Statistics Canada were presented with a joint Award for Excellence by Environmental Systems Research Institute, Inc. (ESRI) in recognition of the collaborative efforts of the three departments in advancing Canada's National Road Network.

ESS Info's Publishing Services received a Special Achievement in GIS award at the Environmental Systems Research Institute, Inc. (ESRI's) 24th Annual User Conference.

Centre for Topographic Information in Sherbrooke, has acknowledged the performance of two Canadian companies, Groupe Trifide Inc. (Quebec) and Groupe Info Consult (Sainte-Foy) for producing geospatial data that surpasses strict technical requirements while maintaining strong links with CTIS technical representatives.

Dr. Stephen Grasby has received the Canadian Society of Petroleum Geologists (CSPG) Service Award for his role in organizing and chairing the first CSPG Gussow Conference, which focused on water resources and energy development.

NRCan Merit Awards recognize teams and individuals who have made exceptional contributions to the Department. This year, ESS recipients were **Claudette Pellikan** for her leadership of the 2004 Science and Technology Week Organizing Committee and **Claude Dubois** for his participation. **Christine Langham, Fiona Warren and Dr. Don Lemmen** were awarded for their work on the *Climate Change Impacts and Adaptation: A Canadian Perspective* Team. **Dr. Simon Hanmer** and **Dr. Mark Williamson** were honoured for their 'Leading Change in Managing, Partnering and Delivering Geoscience Knowledge for Canadians' activities.

Honours

While working on a regional mapping project in the Yukon Territory in 1988, **Dr. Lionel Jackson** discovered a new fossil weasel now named 'Mustela jacksoni' in his honour and the site is known as the "Lionel site."

Dr. Marc R. St-Onge has accepted an appointment to the Department of Earth Sciences at the University of Oxford offered in recognition of his international reputation as a field and metamorphic/tectonic geologist. His research has dramatically improved understanding of the geology of northeastern Canada and led to increased mineral exploration in the region.

During the 32nd International Geological Congress, the voting member countries of the International Union of Geological Sciences (IUGS) elected scientist **Dr. Peter Bobrowsky** to the four-year position of Secretary General.

Dr. Marc D'Iorio was named co-chair of a new working group on polar applications created at the XXth Congress of the International Society for Photogrammetry and Remote Sensing. The polar applications working group will play an important role in providing inputs to polar research in support of International Polar Year 2007-08.

Dr. Carolyn Anglin, **Dr. Jim Ryan**, **David J.W. Piper**, and **Dr. Simon Hamner** have been elected to serve three-year terms as Councillors of the Geological Association of Canada (GAC). **Dr. Martine Savard** was elected to serve as a Councillor of the Mineralogical Association of Canada (MAC).

Earth Sciences Information Centre Celebrates 150th Anniversary

November 10, 2004 marked the 150th anniversary of geological library service in Canada. On this date in 1854, the Legislative Assembly Select Committee on the Geological Survey approved annual funds to create and maintain a museum and a library. This event signified the birth of scientific information services in Canada. Over the next century and a half, the Geological Survey of Canada Library has evolved into the Earth Sciences Information Centre of Natural Resources Canada and has spawned the libraries of the Canadian Museum of Nature, the Canadian Museum of Civilization, and the Canada Science and Technology Museum.

Initially established in Montreal in 1842 under Sir William Logan, the Geological Survey of Canada moved to Ottawa on Sussex Street in 1881. The GSC library was originally based on Logan's personal collection, but it continued to acquire items through gifts, exchanges, and purchases. One hundred and fifty years later, the collections in the four libraries are national resources in the fields of geosciences, anthropology, natural sciences, and science and technology.

Information on the Earth Sciences

The Earth Sciences Information Centre (ESIC) maintains a comprehensive national collection of geoscience information, which Canadians can research in person or electronically. This is Canada's largest earth sciences collection of books, journals, maps, atlases, and photographs, with national and worldwide coverage. Clients can search ESIC's more than two million holdings on the Library's online catalogue, while the GEOSCAN geoscience database provides in-depth coverage of the published research of the Earth Sciences Sector. ESIC offers reference services, an *Ask-a-Geologist* service and document delivery. For more information, see http://ess.nrcan.gc.ca/esic/index_e.php. Requests for document delivery can be sent to ESIC.ILL@nrcan.gc.ca. Enquiries can be sent via the web site or e-mailed to ESIC@nrcan.gc.ca.

The GSC Bookstore carries about 20,000 geoscientific publications that focus on the geological structure and mineral resources of Canada's landmass, including offshore regions. Reflecting the research of GSC staff, the publications range from maps to memoirs that date back to the early 20th Century. For more information, see http://gsc.nrcan.gc.ca/bookstore/index_e.php. Clients may search the catalogue on-line at http://gsc.nrcan.gc.ca/bookstore/catalogue_e.php or e-mail requests to gsc_bookstore@gsc.nrcan.gc.ca/.

The Canada Map Office is responsible for distributing maps of the National Topographic Series (NTS) and other Geomatics Canada map products to a network of Regional Distribution Centres across Canada. Each year, these centres distribute more than 400,000 topographic maps to end users through map retailers around the world. For more information, see http://maps.nrcan.gc.ca/index_e.php or e-mail topo.maps@nrcan.gc.ca.

Celebrating its 80th Anniversary, the National Air Photo Library has more than six million aerial photographs covering all of Canada, some dating back 70 years. The Library indexes and stores all federal aerial photography for Canada and maintains a comprehensive historical archive and public reference centre. For more information, see http://airphotos.nrcan.gc.ca/ or e-mail napl@nrcan.gc.ca.

For information about places, digital maps, facts, geographical information, and learning resources about Canada, see the Atlas of Canada at http://atlas.gc.ca.

The Canada Lands Survey Records (CLSR) is the official public repository of all original plans, journals, field notes, and other papers connected with surveys made under the authority of the Canada Lands Surveys Act. For more information, see http://www.lsd.nrcan.gc.ca/.

Key Earth Sciences Sector Contacts

Assistant Deputy Minister's Office
580 Booth Street, 14th Floor
Ottawa, Ontario K1A 0E4
Telephone: (613) 992-9983
Fax: (613) 992-8874

Earth Sciences Information Centre
601 Booth Street, 3rd Floor
Ottawa, Ontario K1A 0E8
Telephone: (613) 996-3919
Fax: (613) 943-8742

Mapping Services Branch
615 Booth Street, 7th Floor
Ottawa, Ontario K1A 0E9
Telephone: (613) 947-0793
Fax: (613) 995-2000

Canada Centre for Remote Sensing
588 Booth Street, 3rd Floor
Ottawa, Ontario K1A 0Y7
Telephone: (613) 947-1222
Fax: (613) 947-1382

Legal Surveys Division and International Boundary Commission
615 Booth Street, 5th Floor
Ottawa, Ontario K1A 0E9
Telephone: (613) 995-4341
Fax: (613) 992-1122

Sedimentary and Marine Geoscience Branch
601 Booth Street, 2nd Floor
Ottawa, Ontario K1A 0E8
Telephone: (613) 995-2340
Fax: (613) 996-6575

Minerals and Regional Geoscience Branch
601 Booth Street, 2nd Floor
Ottawa, Ontario K1A 0E8
Telephone: (613) 995-4093
Fax: (613) 996-6575

Polar Continental Shelf Project
615 Booth Street, 4th Floor
Ottawa, Ontario K1A 0E9
Telephone: (613) 947-1601
Fax: (613) 947-1611

International Division
615 Booth Street, 5th Floor
Ottawa, Ontario K1A 0E9
Telephone: (613) 996-7643
Fax: (613) 995-8737

GeoConnections Secretariat
615 Booth Street, 6th Floor
Ottawa, Ontario K1A 0E9
Telephone: 1-877-221-6213
Fax: (613) 947-2410

Climate Change Impacts and Adaptations Directorate
601 Booth Street, 1st Floor
Ottawa, Ontario K1A 0E8
Telephone: (613) 947-4880
Fax: (613) 992-0190

ESS Communications Group
588 Booth Street, 3rd Floor
Ottawa, Ontario K1A 0Y7
Telephone: (613) 995-4261
Fax: (613) 996-5872

ESS Policy, Planning and Coordination Division
580 Booth Street, 14th Floor
Ottawa, Ontario K1A 0E4
Telephone: (613) 995-4285
Fax: (613) 996-9670

Earth Sciences Sector Regional Contacts

Contact information for the GSC Regional Offices is as follows:

Calgary: Telephone (403) 292-7000, fax (403) 292-5377 or e-mail info-calgary@gsc.gc.ca

Dartmouth, N.S.: Telephone (902) 426-3225, fax (902) 426-1466 or e-mail info-dartmouth@gsc.nrcan.gc.ca

Québec City: Telephone (418) 654-2604, fax (418) 654-2615 or e-mail info-stefoy@gsc.nrcan.gc.ca

Sidney, B.C.: Telephone (250) 363-6500, fax (250) 363-6565 or e-mail info-sidney@gsc.nrcan.gc.ca

Vancouver: Telephone (604) 666-0529, fax (604) 666-1124 or e-mail info-vancouver@gsc.nrcan.gc.ca

Contact information for the GSC Regional Libraries is as follows:

Calgary: Telephone (403) 292-7165, fax (403) 292-5377 or e-mail calgary.ref@gsc.nrcan.gc.ca

Dartmouth, N.S.: Telephone (902) 426-3683, fax (902) 496-1544 or e-mail biolibrary@mar.dfo-mpo.gc.ca

Québec City: Telephone (418) 654-2677, fax (418) 654-2615 or e-mail gscq_library@nrcan.gc.ca

Sidney, B.C.: Telephone (250) 363-6392, fax (250) 363-6749 or e-mail paclibrary@dfo-mpo.gc.ca

Vancouver: Telephone (604) 666-3812, fax (604) 666-7186 or e-mail libvan@gsc.nrcan.gc.ca

Contact information for the Map and Publications Sales Offices is as follows:

Calgary: Telephone (403) 292-7030, fax (403) 299-3542 or e-mail gsc_calgary@gsc.nrcan.gc.ca

Dartmouth, N.S.: Telephone (902) 426-4386 or fax (902) 426-4848

Québec City: Telephone (418) 654-2677, fax (418) 654-2615 or e-mail sdupuis@nrcan.gc.ca

Sidney, B.C.: Telephone (604) 666-0271, fax (604) 666-1337 or e-mail gscvan@gsc.nrcan.gc.ca

Vancouver: Telephone (604) 666-0271, fax (604) 666-1337 or e-mail gscvan@gsc.nrcan.gc.ca

Contact information for the Legal Surveys Division Offices is as follows:

Amherst, N.S.: Telephone (902) 661-6766, fax (902) 661-6769

Québec: Telephone (418) 648-5725, fax (418) 648-5728

Toronto: Telephone (416) 973-1006, fax (416) 973-1004

Winnipeg: Telephone (204) 983-3793, fax (204) 983-0157

Regina: Telephone (306) 780-5402, fax (306) 780-5191

Edmonton: Telephone (780) 495-2496, fax (780) 495-4052

Vancouver: Telephone (604) 666-5313, fax (604) 666-0522

Whitehorse: Telephone (867) 667-3950, fax (867) 393-6709

Yellowknife: Telephone (867) 669-3949, fax (867) 920-6662

Iqaluit: Telephone (867) 975-6601, fax (867) 975-6624

Contact information for the Centre for Topographic Information - Sherbrooke

Sherbrooke: Telephone (819) 564-5600 or 1-800-661-2638, fax (819) 564-5698

or e-mail NTDB@NRCan.gc.ca

Earth Sciences Sector Across Canada